POPULAR SCIENCE

Mar. 1950 25¢ Monthly

Motorized Tool Kit—page 16

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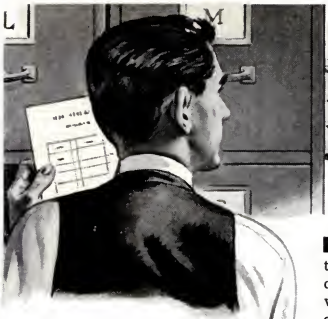

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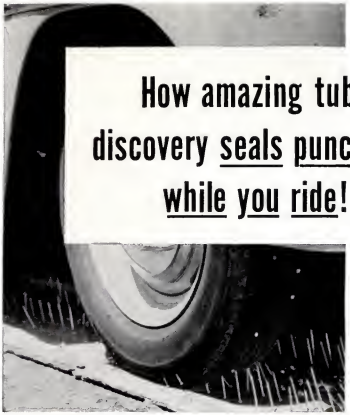
"Perky's" Pal

"PERKY" was a model airplane that Jack Wilson told POPULAR SCIENCE readers how to build last July. Its popularity prompted Wilson to tell you how to build a model car this month. It weighs only 4 ounces but goes 40 m.p.h. You'll find directions for building it on page 221.

How amazing tube discovery seals punctures while you ride!



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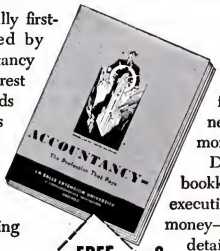

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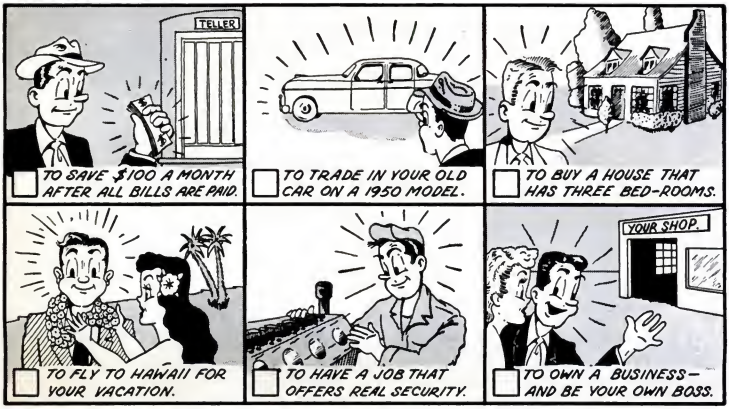

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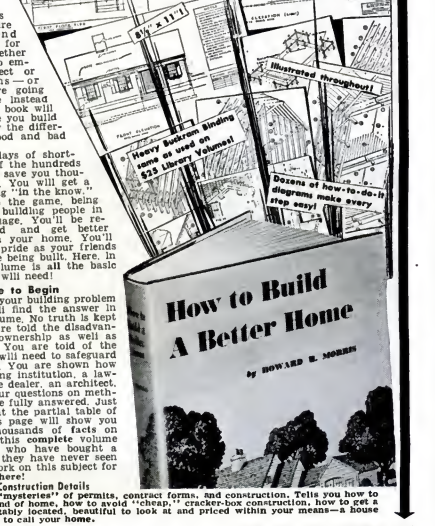

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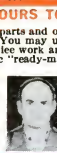

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Letters

Kleberg's First Ranch Car

Sir:

The Buick luxury range car [below] in your January issue [p. 98] is a far cry from the first range car Dick Kleberg had built. I was a boy in high school at the time—around 1920—and was the Delco Light mechanic for that part of Texas after school and week-ends.

The car was a Ford, 1914 or 1915 vintage, and looked rough beside the 12-cylinder Packard touring car next to it.

The hand rails were ¾" galvanized pipe—not silver plated. And they were there for a purpose: the doors had been removed to let you out quick if the car turned over.

The engine, too, had been altered. The ignition was duel Bosch magnetos. The cylinder head was a "roof" over-head type with two exhaust and two inlet valves in each cylinder. It had two Stromberg carburetors and some kind of a water pump.

My first trip in this car was with the late Matt Cody, the ranch foreman, Dick Kleberg, and two dogs—a mixture of thorobred greyhounds from the ranch and anything the hired hands had around the bunkhouse. A driver and I held down the front and kept a close lookout for coyotes. Matt and Dick passed the time by betting quarters which way a steer would run when we came upon one. When a coyote was flushed and run a while, the dogs got to make the kill.

In our chase we bent a radius rod, so the thing wouldn't steer, and one front tire went almost flat. The tires were leather covered with hollow-headed rivets in the tread. A mesquite thorn had gone clear through one, and we had to patch a tube and put in a boot. I also helped to make some extra radius rods out of oak wagon tongues to go between the front and rear axles.

I doubt if Dick has as much fun with his Buick as he did with that old Ford 30 years ago.

ERIC WARREN

Sinton, Tex.

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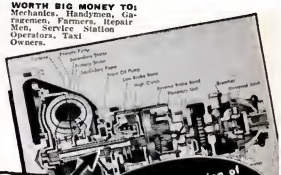

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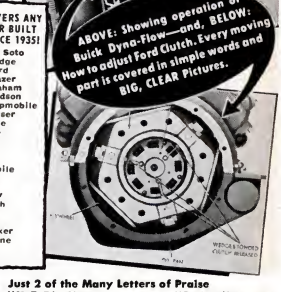

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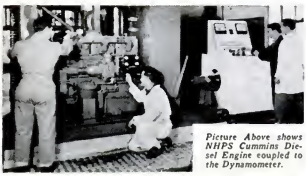

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Why Not Co-ed Bikes?

Sir:

About that suggestion from R. H. Hemfelt [Dec., p. 92] for a boy's bike with a removable crossbar for easy conversion to a girl's bike: Why, in the name of common sense, ARE there "male" and "female" bicycles? Since a sturdy bicycle can be made without that leg-obstructing crossbar, why not make all bikes that way, so the machine would be equally "proper" for use by girls and boys? Why have *gender* in bicycles?

ANDREW VENA

Philadelphia

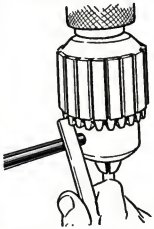
Chuck Trick

Sir:

A while back you showed how to open or tighten a chuck, when the key has been lost, by using a maple dowel, a leather thong, and a steel rod [Sept., p. 213]. There's a much simpler way: just use a screwdriver as a pry against the chuck teeth, bracing it over a rod that fits into the hole in the chuck.

JOHN L. FREY

Cincinnati, Ohio



That'll work, too. But prying isn't a legitimate job for a screwdriver; we'd suggest a brass bar (see sketch), which couldn't hurt the teeth.

The Great Debate

Sir:

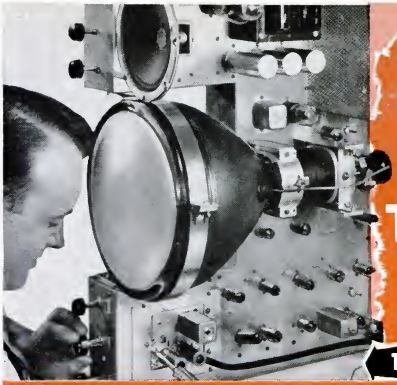
I am fed up with the complaints from some of your other readers against the styling of our new cars. The Cord and Duesenberg were beautiful cars in their time, but times have changed. Today's cars are far more comfortable, more roomy, easier to handle, offer better visibility to help in making driving easier, and are far more economical to run.

HAROLD SCHUMAN, JR.

Wanamaker, Ind.

Sir:

As to the old Cord being expensive to run, mine never used any oil at 102,000 miles and still had the original pistons. Gas mile-



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age averaged around 18 on the highway at 70 to 80 m.p.h. and with careful driving would go up to 21.

To really appreciate one of those truly fine cars, you had to drive it at 60 m.p.h. over glare ice and feel it grab the road like a leech and dig in.

LYMAN E. GREENLEE

Anderson, Ind.

Sir:

I should like to add a personal report to the great debate about the styling of the new cars that has been raging in your Letters column.

Recently I was involved in an argument between my '34 Ford and a '49 car at an intersection. Each got a front fender stove in. Repairs cost about $5 for my car and $200 for the '49.

HUGH B. MCNICHOLS

Boise, Ida.

PS Flagged Down

Sir:

In the December issue [p. 201] you prominently illustrate a model race car being sent on its way by an interesting device actuated by a current of air from the starter's flag.

Equally captivating is the "starter's flag" itself! It is customary in racing events to use a solid green flag for starting. The checkerboard flag pictured in your illustration is always used at the *finish line.*

HARRY G. WALTER and
GEORGE E. FARRIS

Lawrence, Kan.

The car, fortunately, doesn't care what color of flag is waved at it. PS's editors should have been more discriminating.

Marshall Plan for Hobbyists?

Sir:

Every month when I get a new copy of POPULAR SCIENCE, I must envy my lucky American co-hobbyist. Lucky, because he can afford to buy those beautiful machines I see on many a page each time.

Considering the difference in wages, those saws, shapers, and drill presses would cost me proportionately *four times* as much. That puts them practically out of the question for the common man over here.

I can only hope that, one day, some U. S.

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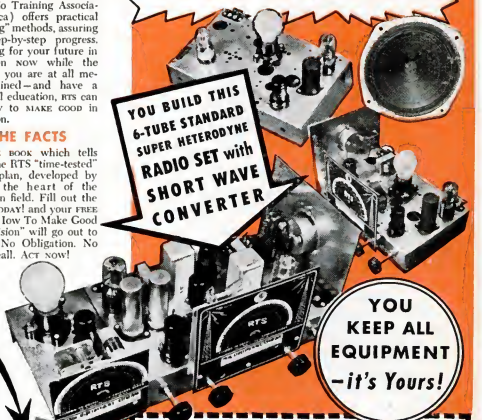

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Santa Claus will put up a private Marshall Plan for hobbyists. Till then, I'll go on reading PS while day-dreaming.

ERNEST E. VAN HERCK

Antwerp, Belgium

Sound Idea

Sir:

Your "telephone of the future" [Oct., p. 170], with the user speaking into its sound-focusing lens from several feet away without using a handset, looks *unsound* to me. Wouldn't it also pick up other sounds and be difficult to use in a room where there were noises like typewriting?

LEO D. KELLER

Rochester, N. Y.

The gadgets developed by Dr. Winston E. Kock, of Bell Telephone Labs, are lenses that focus sound just the way glass lenses focus light. The lens on the transmitter works like a telescope—it is focused on the user and picks up only sounds from that spot. It would no more "hear" noises from anywhere else in the room than a telescope aimed at the user would "see" other objects.

1,500 Percent Wrong

Sir:

I note in your December issue, p. 119, that the British have gone to the trouble of rigging up eight parachutes for the purpose of air-dropping a jeep and a "6-mm. gun." I can see dropping a jeep, but why a jeep to carry a 6-mm. gun? Six millimeters, according to my calculations, is equal to 0.23622 inches—a gun a little larger than a .22 rifle!

JEROME E. SALNY

Morristown, N. J.

PS carelessly repeated an error from an official British picture caption. The gun is, of course, a British "six pounder"—which has a bore of 3.67 in. and thus is somewhat larger than a U. S. 75-mm. gun.

Dissatisfied Reader

Sir:

As far as I know, there is only one thing wrong with PS: you carry a hot-rod article only about twice a year. Why not one every month?

PHIL MICHMERSHUIZEN

Holland, Mich.

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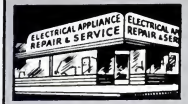

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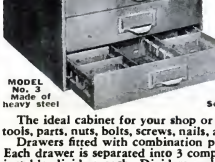

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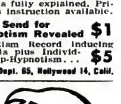

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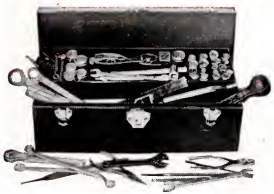

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WHAT YOU CAN DO ABOUT PIMPLES

Acne, Blackheads, and other externally caused Skin Blemishes

WHEN pimply skin is your problem, the first thing to get straight is that you *can* and *should* do something about it. To develop the attractiveness of your face is not mere vanity. It is an "open sesame" towards bringing the real YOU closer to other people and giving your personality the poise and confidence it needs. Your good qualities—intelligence, character, dignity—all go to naught... are completely cancelled out by a skin that "nobody loves to touch." Remember, the YOU that people see first is your face.

SKIN PROBLEMS DEMAND IMMEDIATE CARE

Medical statistics tell us that blemished skin usually occurs from adolescence on through adult life. The problem at the adolescent stage is serious enough to deserve attentive care as a family matter. In adulthood, when life's responsibilities are so much weightier, it is doubly important to exert great effort to eliminate these blemishes. And, there is no better time to get pimples under control than *now*.

DON'T ABUSE SKIN

The first instinctive reaction to pimples and blackheads is to squeeze them out with your fingers. A bit of experimentation along these lines soon provides convincing proof that this succeeds only in inflaming your skin and spreading the infection. Under no circumstances should pimples and blackheads ever be squeezed.

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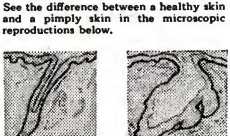
MICROSCOPE SHOWS IMPORTANT BASIS FOR EXTERNALLY CAUSED PIMPLES AND BLACKHEADS

Let's take a look through the microscope to see what's behind those unsightly pimples. The high-powered lenses show your skin coated with a covering which originated from two sources—one, internally and the other, externally.

The internal substances on your skin include dead cells, residue from the sweat glands, and a high quantity of oil excreted by the sebaceous glands. A most important factor in skin disorders occurs when thousands of these tiny sebaceous glands discharge more oil than the skin can use for lubrication. Unless special care is given, the oil forms a heavy film which attracts foreign matter to your skin much as any oil mop picks up dust. These infectious external substances may be classified into three general groups:

1. Airborne materials such as dust, pollens, condensation products of smoke, vapors, etc.
2. Materials brought in contact with the skin, such as tiny fragments of clothing, bedding, cosmetics.
3. Micro-organisms such as bacteria and fungi.

See the difference between a healthy skin and a pimply skin in the microscopic reproductions below.



A. Normal skin **B. Sick, pimply skin**

Diagram A shows a normal-size, smoothly functioning sebaceous gland. Diagram B pictures sick, pimply skin. Notice that the sebaceous gland is a swollen mass of trapped oil, waste and infectious bacteria.

TRY THIS SENSIBLE WAY

Two sensible aims to achieve in controlling this skin condition are: to clear the pores of clogging matter, and to inhibit the excessive oiliness of the skin. Toward these ends, Dornol Products' research makes available two formulas. One is to aid in thorough cleansing by highly detergent penetration which simplifies the removal of waste and foreign matter. The other is to discourage oiliness with clinically-proved ingredients, and to kill infectious bacteria often associated with externally caused pimples and blackheads.

BLEMISHES COVERED UP

To remove the distressing embarrassment of these skin blemishes, the second Dornol formula exerts a "cover-up" action on your broken out skin while the medication does its work. This, plus its pleasant odor, will spare you the mental distress which is associated with unsightly, malodorous, medicated preparations. Imagine! You can apply this Dornol formula to your skin by day and face the immediate present with greater confidence in your appearance, while secure in the knowledge that medication is acting to remove old blemishes and keep away new ones. What this "cover-up" action alone is worth in peace of mind is beyond calculation. No longer need prying eyes make you wince with humiliation and misery. Now because of this wonderful feature of the Dornol treatment, you can put your best foot forward ...at once!

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We know what the Dornol treatment has done for others, so we want you to try it at our *risk*. A few minutes a day invested in our treatment can yield more gratifying results than you ever dared hope for. This is what we say to you: If you are not delighted in every way by the improved condition and general appearance of your skin in just 10 days, simply return the unused portion and we will refund not only the price you paid—but DOUBLE YOUR MONEY BACK! Can anything be fairer than that? You have everything to gain... *and we take all the risk!*

How to get the Dornol Treatment immediately: Just send your name and address to DORNOL PRODUCTS, INC., Dept. 4515, 4257 Katonah Ave. New York 66, N. Y. Be sure to print clearly. By return mail we will ship the Dornol treatment to you in a plain package. When postman delivers the package, pay only $1.98 plus postage. Or, if you wish to save postal fee, send $2 now and we will pay postage. Which ever way you order, the DOUBLE REFUND GUARANTEE still prevails. Don't delay another minute, send for the Dornol Medicated Skin treatment with "cover-up" feature... *at once!* Sorry, no Canadian C.O.D.'s.

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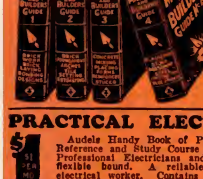

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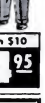

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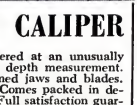

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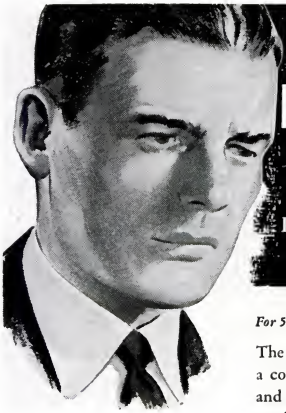

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650x15 5.28	650x16(6) 6.98	32x6(8) 10.48	1000x20 16.48
700x15 [illegible]	700x17 8.88	32x6(10) 12.48	1100x20 17.[illegible]
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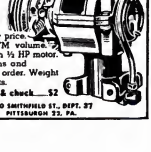

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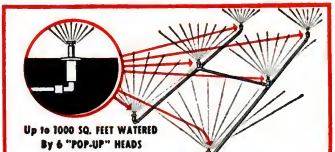

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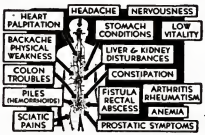

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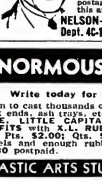

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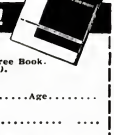

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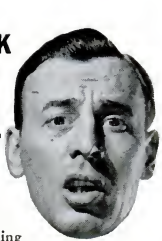

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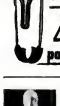

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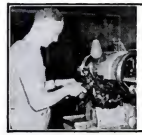

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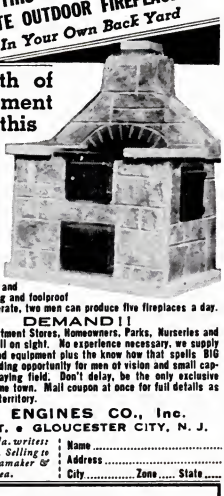

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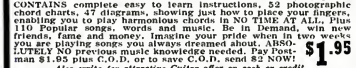

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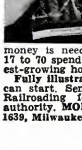

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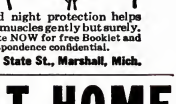

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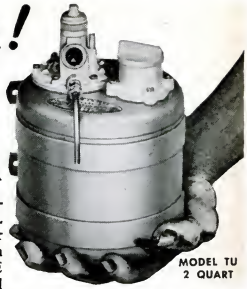

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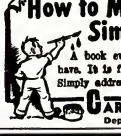

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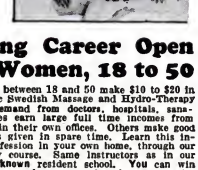

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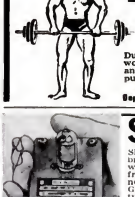

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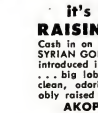

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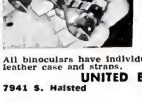

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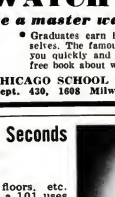

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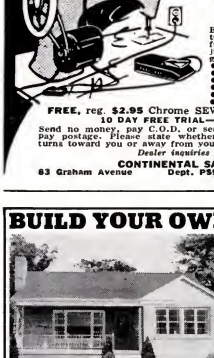

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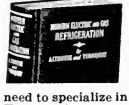

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PLASTIC'S Low Prices, catalog, instruction booklet 25c. Plastic's, Box 1415, Salt Lake City 11, Utah.

60 CHEMICALS AND APPARATUS

NEW Idea Chemical and Apparatus Outfits for Home Experimenting, Photo-Scales, Microscopes, Chemicals, Biological and Laboratory Supplies in Small Quantities. Catalog 15c. Established 1931. John R. Winn, 124-B West 23rd Street, New York 20, N. Y.

LUMINOUS Paints will glow in dark. Six colors, Fairmount Chemical Co., 136 Liberty St., New York City 6.

NEW Laboratory supplies catalog of Chemicals and Apparatus. Contains many thousands of items with illustrations. Send 25c. Standard Science Supply Company, 1232 N. Paulina St., Chicago 22.

USEFUL Laboratory item, catalog of chemicals, laboratory apparatus, 10c. Rex Laboratories, 2849S Birchwood, Chicago 45, Illinois.

NEW, Used Catalog 10c refundable. Atlantic Laboratory Supply, 21 Wenham, Boston 17, Mass.

ILLUSTRATED Catalog: Chemistry, mineralogy, biology, 10c. Tracey Laboratories, Evanston, Illinois.

CHEMICALS and apparatus for industrial, analytical, and private laboratories. Catalog 15c. Dept. M-26. Biological Supply Co., 1176 Mt. Hope Ave., Rochester 7, N. Y.

61 HELP WANTED

IMMEDIATE opening for reliable man with car to call on farmers. No experience necessary. $15 to $20 in a day. Permanent. McNess Company, Dept. 214, Freeport, Ill.

INTERESTED in Latin American and Foreign Employment??? $1.00 Brings 1950 Copyrighted "Foreign Service Directory" with new complete listings in US & Canadian Reconstruction Companies; World-wide Oil Firms, Mining, Aviation, Steamship, Transportation; Manufacturers; Importers & Exporters; Domestic & Foreign Listings. Special Daily Listing of firms hiring. Tells How-When-Where to apply. Publication Form. Global Reports, P. O. Box 883-S, Hollywood 28, Calif.

ALASKA—The Great American Frontier offers unlimited opportunities. $1.00 brings 1950 Copyrighted Report & Government Map. Business Directory listing Big Construction Projects; Fishing, Mining; Aviation; Hunting—Fishing—Game rules, Fur-Farming, Lumber; Agriculture; Live Stock Raising; Transportation; Homestead & Highway information. Hot list of firms hiring. Alaska Opportunist, P. O. Box 883-S, Hollywood 28, Calif.

MAKE $20 a day! Complete line, Door name plates, knockers, numbers. Hubstamp, 359-B Congress, Boston, Mass.

JOB Opportunities Anywhere. U.S.A. May vacancies. Housing information. Free particulars. Business Press Services, Baldwinsville, N. Y.

$1.000.000 CONSTRUCTION Job Project Report. $1.00 brings Monthly News Bulletin giving authentic projects starting "world wide" U.S.A., Alaska, Canada, Pacific, Arabia, Latin America, Indian, Mexico, Africa, Europe. Tells How-When-Where to apply. Global Reports, P. O. Box 883-PX, Hollywood 28, Calif.

62 AGENTS WANTED

PHOTO-Salesmen-Agents. Sell beautiful hand-colored plastic enlargements. Collect deposit, we deliver. Profitable sideline. Send card for free sample kit. Novel Portrait Co., 3343-A North Ave., Chicago, Ill.

SEWING Machine electrification kit. Nationally advertised. Has Good Housekeeping Guaranty Seal. Can be demonstrated and sold in 5 minutes. Make at least $5 per sale. For complete details write today to Brownell Distributors, Inc., Dept. PS, 308 Canal St., New York 13, N. Y.

NYLON, Poplin, Rayon Uniforms, white and colors. Immediate Delivery. Immediate Profits. Sell to Doctors, Dentists, Nurses, Waitresses, Beauticians, Housewives. Free Sales Kit. Superior Fabrics, Dept. A-1, 3936 Market St., Phila. 4, Pa.

WHERE To Buy 400,000 articles direct from Manufacturers. Save by buying direct. Sent Free. "Your Profits Under the Spotlight." Glass Pub. Co., Ellwood City 3, Pennsylvania.

LOOK! Make money all year round selling personal initialed individualized belts, buckles, cap badges, tie holders, complete line Police and Firemen's Badges. 2000 emblems to choose. Big profits, whole or part time. Please write today special outfit offer. Hook-Fast Specialties, Box 1425, Dept. 7, Providence, R. I. Established 1926.

ADVERTISING book matches—Cash in on big demand—sell Union Label matches. Cuts for all businesses and political parties—Free powerhouse selling kit—low prices—protection guaranteed on repeat orders—Cash commissions. Superior Match Co., Dept. P-250, 7530 Greenwood, Chicago.

FREE Samples, and amazing plan, giving you Gorgeous Dress without penny cost. Rush name today, with dress size. Harford Dept. 1-PS, Cincinnati 25, Ohio.

ABSOLUTELY Free! Big package actual sample fabrics and style presentation of dresses, lingerie, hosiery, etc. Take orders. Commissions paid. Send no money. Meiville Co., Dept. 5280, Cincinnati 3, Ohio.

MAKE Money Calling on Friends. Show nationally advertised Greeting Card Assortments—Identify Occasion. Assortment only $1.00—also Birthday, Gift Wrapping, Plastics, Imported English Napkins, Floral Stationery, Children's Books, many more! Up to 50c profit on each assortment. Experience unnecessary. Samples on approval. Write Wallace Brown, 225 Fifth Avenue, Dept. J4, New York 10.

FREE Samples. "Big profits showing amazing Glow-In-The-Dark Novelties, House numbers, pictures, plastic novelties, ashtrays, keyholders, religious and nursery objects, etc. Perfection Plastics, 305 Fourth Ave., New York 10, N. Y.

EXCELLENT Sideline for printing and advertising salesmen. Decalcomania name plates in small quantities. Great demand. Also, make money with our line of Automobile Initials and Sign Letters. Free Samples. "Raico", XL-Roxbury, Boston 19, Mass.

START Your Own Business on Credit. Always your own boss. 1554 Dealers, sold $5,000 to $20,000 in 1948; their average $6,742. We supply stocks, equipment on credit, 200 home necessities. Sales experience not needed. Write for Special Opportunity to own pleasant, profitable business backed by world-wide industry. Write Rawleigh Co., Dept. 1-292-SC, Freeport, Ill.

FREE! Big box actual full-size packages groceries, home needs, sent Free F.O.B. factory. Try them at home and show friends. World-beating money-making opportunity. Write Zanol, Dept. 8091-C, Richmond St., Cincinnati 3, Ohio.

BE First! Sell this sensational new assortment. Contains exclusive Birthday card line. The invitations, table cover, napkins, nut baskets, place cards, snapper hats, cups, plates, game booklet and six different games, a complete party for eight. Sample $1.25. Also America's leading greeting card line featuring personalized stationery, napkins, book matches and exclusive new Birthday invitations. Free Samples. Elmcraft Chicago, 5930 S. Western, Chicago 36, Illinois.

LOOK! Make money all year round selling personal initialed individualized belts, buckles, cap badges, tie holders, complete line Police and Firemen's Badges. 2000 emblems to choose. Big profits, whole or part time. Please write today special outfit offer. Hook-Fast Specialties, Box 1425, Dept. 7, Providence, R. I. Established 1926.

DOUBLE Your Income—Sell wool and Cotton uniforms. Badges, Initial Buckles, Belts, etc. Write Hook-Fast, Box 480PS, Roanoke, Virginia.

NEWEST money-making sensation, miniature authentic replicas, police and firemen's badges also pocket pieces, key chains. Write for descriptive folder. Hook-Fast Specialties, Dept. 23, Box 1425, Providence, R. I.

SELL Slot Machines, Games, Home Bars. Send for wholesale list. Bell Distributing Co., 4958 West Chicago Ave., Chicago 51, Ill.

GOLD lacquered Window Sign Letters. Large Sizes Penny Each. New Foils. Absolutely Beautiful. Free Samples. Atlas, 544 W. 79th, Chicago 20.

"SUCTION" Auto Washer. New invention. Mirror finish. Banishes autowashing drudgery. Lightning seller. Samples sent on trial. Kristee 145, Akron, Ohio.

MAKE $50 selling America's leading All-Occasion greeting card assortments. Samples on approval. Complete line fast money makers—free samples imprinted and monogrammed Stationery, Napkins and Guest Towels. Write Lorain Art Studios, Dept. AP, Vermilion, Ohio.

STRANGE "dry" Window Cleaner. Sells like wild. Replaces messy rags, liquids. Simply glide over glass. Samples sent on trial. Kristee 146, Akron, Ohio.

SELL Big Money-Maker to men and Women. Easy handwork makes fast-selling useful articles. Sample free. Sunmade Company, Brockton 64, Mass.

EXTRA Money! Sell new, different greeting cards. Complete line includes Regal Plastic assortment, metallics, "Stand-Up" and "double" cards. Free samples. Exclusive Imprinted and Engraved Stationery. Sales Kit on approval. Regal Greetings, Dept. PS-13, Hazel Park, Mich.

AMAZING Offer—$40 is yours for selling only 60 boxes—entirely different, new Deluxe All-Occasion assortment with television card, Little Pearls, Hankie Gift Greetings, other surprising items. Feature boxes on approval. Free samples imprinted stationery and Rose Scented Notes. Write today. Ev-Ryone, Nothing to Sell, Cheerful Card Co., 1227, White Plains, N. Y.

BIG Bargains for Big profits. Over 100 sensational values. Men's used suits $2, shoes 20c. Topcoats $1.25, overcoats $2, shoes 20c. Experience unnecessary. Free wholesale catalog. Superior, 1250-B Jefferson, Chicago 7.

SELL Ultra-blue stock signs to stores. 1000 slogans, comedy, general, religious. "7 x 11" cost 6c, sells 35c. Make money. 15 samples $1.00 postpaid. Lowy, 8 West Broadway, Dept. 512, New York 7.

EASY dollars even for beginners! Sell friends Plastic greeting cards. Scented Stationery. Profits to 100%. Bonus, Glamorous Metal Poll, Little Pearls, Hankie Gift Greetings, Irresistible novelties. Free samples imprinted, Decorated Stationery, Deluxe All-Occasion samples on approval, Special offers, Write Pilgrim Greetings, 1 Bluminty, Dept. 1-PS, Boston, Mass.

JEWELRY For Salesmen Distributors Direct Factory. Catalog Free. Pickcraft (c 19) Bank St., Attleboro, Mass.

MEXICAN feather pictures. Big profits! No investment! Free details. Samples 25c stamps. Sylvia-S, Apartado 9036, Mexico City.

$85.00 WEEKLY selling 4 pair shoes daily direct. Free Outfit. Samples. No investment. Experience unnecessary. Advance commissions, bonus. Paragon Shoes, 738 Columbus, Boston, Mass.

YOU positively sell our business cards by Mail. Successful "Beginners" gain fast lifetime repeat orders mailed you. Free Details. Lynn, 5710-C Bankfield, Culver City, California.

CANVASSERS! Crew Managers! A Penny post card brings you full details on how you can become a direct factory dealer in your area without any risks, with our beautiful, popular priced, fast selling stainless Tableware. Guaranteed for Lifetime! Enormous Profits! Dept. PS, John Hull Cutlery Corp., 1239 Broadway, New York City, N. Y.

EARNINGS of $25 to $100 weekly possible selling established family shoe line direct to consumer. 70 styles. Amazing comfort features. Samples to producers. Experience unnecessary. Mench Shoes, MH-26, Brockton, Mass.

COLLECT easy profits to 100%. Sell biggest line greeting cards. Plastic Everyday, Comics, Gift Wrappings, Scented Floral Stationery, Hankie Gifties, Plastic tablecloths, novelties bring money galore. Bonus. Write today for Deluxe All-Occasion Gift Hankie assortment on approval and Special offer. Tom-Wat Studios, Dept. PS, Bridgeport, Conn.

FREE samples Personalized Stationery, Napkins, Coaster. Matches bring you extra money! Customers buy on sight. Profits to 100% selling sensational new Plastic Greeting Cards. Gift Wrapping, Comics, Children's Books, Big demand. Experience unnecessary. Write today. Senrab Co., 129 North Warren St., Syracuse, N. Y.

SELL Ultra-blue stock signs to stores. 1000 slogans, comedy, general, religious, "7x11" cost 6c, sells 35c. Make money. 15 samples $1.00, postpaid. Lowy, 8 West Broadway, Dept. 53-L, New York.

BIG money in decals—entirely new line of name plates—tremendous demand—also terrific new monogram display set ups to retail stores. Sells on sight. Constant repeats—Excellent side line printing and advertising business—Sample outfit—Enco, 817 W. Cumberland—Phila. 33, Pa.

HOT Special! Power Mowers—$59.50. Delivered. World's cheapest. Modern, 7401-Bet North Kansas City, Mo.

HOUSE Painter—Your name on label. Agents wanted. Experience unnecessary. Free sample. Certified Products, Louisville, Kentucky.

FREE Literature—Thousands Wholesale supply sources. Moneymaking Business ideas. Wilkin, Hillsboro 2, Ohio.

$1 starts you in business. Fast top quality $1.00 tie. Now only $7.20 dozen, your profit $4.80 dozen. Regular $1.50 up values. Send $1.00 for Introductory Offer two ties. Catalog complete line free. Philip's Neckwear, 20 West 22nd St., Dept. P-40, New York 10, New York.

FAST profits—No investment. Send for big, free catalog. Plastic aprons, tablecloths, etc. 150 sure-fire items. We guarantee sales. Write The Ballinger Company, Dept. P-3, 347 Broadway, Passaic, N. J.

SELL $2 Fire Extinguishers. Locally mailorder. Lorrac Products, Albany 1, N. Y.

WOULD you pay 3% —first $350? Booklet "505 Odd, Successful Enterprises" free! Work Home. Expect something odd! Pacific B. Oceanside, Calif.

AGENTS. Sell finest food products direct to homes. Successfully sold over 25 years. Big profits. Powerful combination sale plans make sales easy. Permanent repeat business. Powerful premiums and free door openers for easier sales. Samples furnished Live territories open to distributors. Mother Hubbard Products Co., 4139 Grand, Dept. S-Z, Chicago.

50% COMMISSION. steady repeat orders, lifetime income, free outfit. Nichols Company, Purvis, Miss.

AT last! Something New and Sensational in Everyday Cards. Make Extra Money Fast! Show Gorgeous Selection Velvet Metallic Cards. Get orders easy. Scented Stationery, Charmettes, Napkins, Kiddie Cards. 25 other Assts. Sell 60c to $1.25. Samples on Approval. Pure Co., 2801 Locust, Dept. 000, St. Louis 3, Mo.

SELL!! Balloons, Combs, Specialty Merchandise. Carleton House Distributors, Texas City, Texas.

MAKE money fast selling biggest line greeting cards—21 for $1.00. All-Occasion, Birthday, Easter, Mother's Day, Friendship, Anniversary, Comics, Relative, Catholic, New Metal and $1.00 Plastic Cards, Little Pearls, Twice as Nice, Lustre Beauty, Bright Spots, Nifty Gifties, Scented Stationery, Children's Books, Gift Wrappings, Ribbons, Gifts, Plastic Thread Box, Draperies, Handkerchiefs, Imported Napkins, Eversharp Pen Set. Everyone a prospective customer. Amazing profits for agents, church groups, clubs. Extra cash bonus plan. Experience unnecessary. Write Today for Samples on approval and special offer. Hedernkamp, 361 Broadway, Dept. PS-5, New York.

BUY Thousands of Nationally advertised products direct from manufacturers and distributors. Write for "Buy direct and Save." Service Publishing, 2B-B Investment Bldg., Pittsburgh 22, Pa.

LEN'S Glo. Amazing new eye glass lens cleaner. Sell individuals direct wholesale to stores. Whirlwind repeat seller. Big profits. Carroll, 9321 Buckeye, Cleveland, Ohio.

PROFIT Making Novelties—Two for samples $1.50—Folder free. Roger Enterprises, Waverly Place, Tuckahoe, N. Y.

AGENTS—300% profit selling genuine gold window letters; stores and offices. Free samples. Metallic Letter Co., 437 N. Clark, Chicago.

SENSATIONAL nylons guaranteed against runs. Nationally advertised. Sell direct in stores. No experience or money needed. Also lingerie, robes, men's hosiery. Outfit, sample, etc. Free. Wonderful opportunity earn big money spare or full time. See our full page advertisement on page 71. Kendex Co., Babylon 749, N. Y.

NEW Duplex Ball Point Pens. Cost 50¢ —sell $1.00. Sample $1.00. Amhar Industries, Plant 3B, Huntington, New York.

AGENTS—300% Profit selling genuine gold window letters: stores and offices. Free samples. Metallic Letter Co., 437 N. Clark, Chicago.

CASH in on tremendous demand for new low priced burglar alarm for Cars, Homes and Buildings. Nothing like it. Everybody wants one. 286% Profit. Unique sample offer. Northwest Electric Company, Dept. C-20, Pukwana, South Dakota.

MAKE over $100.00 a week. Each sale you make $10.00 Selling on Installments. Watches: Bulova, Longines, Elgin, Benrus, at $3.00 weekly. Easy to sell. Supply samples. Car necessary, for new open territories. Furnish References. Ergim Co., Inc., (Wholesalers), 992 Columbus Ave., New York City.

$18 AN Evening for you! Spend just two hours showing housewives Exclusive D-Frost-O-Matic Refrigerator control. Saves Time . . . Food . . . Money. Sure-Fire Sales plan. Write today. No obligation. D-Frost-O-Matic, 6 N. Michigan Ave., Chicago 2.

SELL Household Air-Freshener, cosmetics, etc. Amhar Industries, Plant 3C, Huntington, N. Y.

63 HIGHGRADE SALESMEN

BIG Money Taking Orders: Shirts, Ties, Sox, Pants, Jackets, Sweaters, Shoes, Uniforms, etc. Sales equipment free. Experience unnecessary. Nimrod, 4922-AV Lincoln, Chicago.

START your own business on Credit. Always your own boss. 1554 Dealers sold $5,000 to $26,500 in 1948; their average $6,742. We supply stocks, equipment on credit, 200 home necessities. Sales experience not needed to start. Wonderful Opportunity to own pleasant, profitable business now being offered individuals. Write Rawleigh Co., Dept. C-U-PSC, Freeport, Ill.

EARN Big Money Fast! Sell finest quality advertising work uniforms to garages, factories, filling stations, etc. Free selling kit. Topps, Dept. B-20, Rochester, Ind.

SALESMEN, Earn $50.00 weekly, selling only three pairs shoes daily. Commission and bonus. Wide variety for men, women, children. No investment. Experience unnecessary. Free catalog. Tanners Shoes, 560 Boston, Mass.

SALESMAN-Sideline. Earn $3,000 next 5 months selling calendars, advertising specialties. Business everywhere. Big Custom, Advanced, Samples Free. Continental Calendar, 542-B South Dearborn, Chicago.

"BIG Pay—Travel South America Pacific—Europe—Alaska. Construction, Oil, Mining, Manufacturing firms hire clerks, Engineers, pilots, many trades—pay bonuses. We can help you make connection. Dollar brings advice where, how apply. Personnel Services, Box 785, Sacramento, California 11."

SALESMEN—Put yourself in line for big money, real future. Keep stores supplied with 5c-10c to $1 counter goods. Nationally advertised. Big profits for you and merchants. Liberal deals boost sales. Side-line or full time. World's Products, Dept. 83-D, Spencer, Ind.

BIG Cash Profits for men and women introducing Flexiclogs, sensational new flexible footwear. No investment necessary. Nationally advertised styles for women, children, men. Excellent sideline, no investment. Earn up to $10 profits for you and dollars weekly. Free sales helps and sample offer. Get details now! Flexiclogs, Dept. B-12646, New Brunswick, Wisconsin.

SENSATIONAL Nylons guaranteed against runs. Nationally advertised. Not sold in stores. No experience or money needed. Also lingerie, robes, men's hosiery. Outfit, samples, etc. Free. Wonderful opportunity earn big money spare or full time. See our full page advertisement on page 71. Kendex Co., Babylon 749, N. Y.

67 EDUCATIONAL AND INSTRUCTION

BE A real estate broker through home study or classroom instruction. Write for free book. Approved for veterans. Weaver School of Real Estate, 15 E. Pershing Rd., Box PC-11, Kansas City 8, Mo.

WANT a steady Big Pay Job in Diesel? Our approved, easy-to-understand Diesel Training Course qualifies you. Placement advisory service Free. Learn as you earn. Write for free 24 page book today! Interstate Training Service, Dept. 2N, Portland 13, Oregon.

BOOKKEEPERS! Increase your earnings! Operate your own simplified "Dollar-A-Week" Bookkeeping and Tax Service. Full or spare time. Details Free. No obligation. Ellis, Box 203, Cedar Grove, North Carolina.

PIANO Tuning Pays. Learn this profitable profession at home. Our Tonometer and mechanical aids make learning easy. No knowledge music necessary. Diploma granted. Largest and oldest school—51st year. Approved. Write for booklet. Niles Bryant School, 77 Bryant Bldg., Washington 16, D. C.

INCREASE your Poultry Income—thorough knowledge means greater success. Our interesting, practical, home study course has trained thousands during past 39 years. Don't delay—write today for free booklet describing courses, methods, opportunities. National Poultry Institute, Dept. 73, Adams Center, New York.

MAKE Up To $35-$45 Week as a Trained Practical Nurse! Learn quickly at home. Booklet free. Chicago School of Nursing, Dept. M-3, Chicago.

EXPORT! Learn at home from established World Trader. Big paying positions. Your own profitable world-wide business by mail order without capital; or travel abroad. Experience unnecessary. 39 booklet. Mellinger, 203-W, Los Angeles 24, California.

HYPNOTISM. Complete course. 20 illustrated lessons $1.00, moneyback guarantee. Baltimore School of Hypnotism, Dept. 23-A, 4214 Belmar Ave., Baltimore 6, Md.

LEARN the Collection Agency business. Highly profitable. Easily mastered. Free folder. Cole Associates, Syracuse 2, N. Y.

YOU For President of your own credit-collection business. Many who answered our ads now head their name on office doors. Franklin Credit, Roanoke 7, Va.

LEARN Gunsmithing! Details, copy "Guns and Gunsmithing" 25c. Gunsmith, Palatine 3, Illinois.

USDA Correspondence Courses. Bought, Sold, Rented. Free Literature. Baker, 5509-A Winthrop, Chicago 40.

LOCKSMITH Course. Lock-Picking, keyfitting. $1.00 prepaid. Miller, Holdrege, Nebraska.

BECOME a Doctor of Psychology or Metaphysics. Teach secret of contentment, happiness. Win degrees: Ph.D., Psy. Mall. Solve mental worries. Free book. College of Universal Truth, 5153-K N. Clark, Chicago.

MEDICAL Laboratory Technicians in great demand. We train you in your own home. Catalogue free. Imperial Technical Institute. Box 973-B. Austin, Texas.

LEARN Piano Tuning. Repairing—at home in 30 days. Unlimited income. Phonograph recordings, tools and instructions furnished. Write Capitol City Tuning Co., Department C-323, 129 East Michigan, Lansing 16, Michigan.

AUTOWELD training pays. G. I. Approved School. Free Catalog. Hobart Welding School, Box P-303, Troy, Ohio.

ARC Welding transform bodies, fenders. Pays with Hobart Welders. Easy terms. Catalog free. Box P-302, Troy, Ohio.

WANT $66.34 A Week? U. S. Civil Service Jobs. Men-Women. You can qualify Now for permanent Jobs. Many openings expected soon. Write today for Free 40-page book showing jobs, salaries, sample tests. Franklin Institute, Dept. C-22, Rochester, N. Y.

USED Correspondence Courses and Educational Books Bought, Sold, Rented. Catalog Free. Educational Exchange, Summerville, Ga.

PHOTOGRAPHIC mind with Supermemory, write Thor Books, S-11, Box 1210, Chicago.

FASTER Mind! Try "Thinking-Alphabet." Write Frank Tibolt, 17A. Phila. 20.

68 DANCE INSTRUCTION

CONQUER "Danceritis" (Fear of Dancing) Scientifically. Free Aptitude Tests—Lessons. Psycho-Danceology, 35-W, Warren, Youngstown 7, Ohio.

69 CONTESTS

WIN Cash, Cars In Prize Contests! Write for copy filled with current contests, winning hints and tips. Send only 25c. Wright Contest Digest, Dept. 20-B, P. O. Box 2266, St. Louis 9, Missouri.

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70 LANGUAGE OUTFITS

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72 AUTHORS SERVICE

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74 CARTOONING, SIGN PAINTING, DRAWING AIDS

"HOW to make money with simple cartoons". A book everyone who likes to draw should have. It is free; no obligation. Simply address Cartoonists' Exchange, Dept. 193-C, Pleasant Hill, Ohio.

CARTOON Your Way To Success! Internationally known instructor, Raye Burns, will personally teach you to create salable, original cartoons at home. Course of 26 lessons only $2.85. Send remittance with order or write for Free Details and addresses of successful students. Raye Burns School, Box 2583-S, Cleveland 18, Ohio.

SIGN painting taught at home. Test lesson free. Ben Kerns, Box 812-PS, Greenville, S. C.

FIVE Art Books. Hundred pictures. Postpaid. Guaranteed. Send $1.00. Artistry, 3606 Amesbury, Los Angeles 27, Calif.

MICALITE Sign Letters! Reflect Light! Sample 25c. Harwell, Syrdstown, Tenn.

LEARN Professional Lettering, Amazing Mechanical Process. Instruction Manual Illustrating 75 alphabets, 250 designs, $1.00. Major-Art Studios, 3519-W Palmer, Chicago 47.

EXCLUSIVE Booklet Offer—"200 places to sell your cartoons!"—only $1.00. Bob Knapp, Gas City, Indiana.

75 CHALK TALK-STUNTS

CHALK Talks. Laugh Producing Program, $1.00. Illustrated Catalog 10c. Cartoonist Balda, Oshkosh, Wisconsin.

76 TYPEWRITERS AND OFFICE MACHINES

STANDARD Typewriters $17.50 up. Duplicators $9.50. Adders $12.50. "Typewriters." 118 Spruce, Wichita, Kans.

77 OFFICE SUPPLIES & EQUIPMENT

MIMEOGRAPH Paper, 68c Ream, samples. Brookman, 56-C West 24th, New York 10.

FAST figuring secrets in "How to Use the Chinese Abacus." $1.00. Low-cost fast adding-calculators available. Free circulars. W. D. Loy, 1317 R. I. Ave., N.E., Washington 18, D. C.

OFFICE supply catalog—latest items, 10c refunded first order. Eddy Co., Southington 12, Conn.

79 PRINTING OUTFITS, SUPPLIES

PRINTING Presses, Type Supplies, Lists 3c. Turnbaugh Service, Loysville, Penna.

HOBBY Printers—Join American Amateur Press Association, 822 South Orleans, Tampa, Florida.

NEW precoloraminating press half price. Nichols Photo, Bristol, Pa.

MAKE your own rubber printing cuts. Self molding process, Flexirubber, Argyle 2, Wisconsin.

80 PRINTING, MULTIGRAPHING, ETC.

MIMEOGRAPHING; Free samples! Topical Empire, 1527 Highland, Box 42 B, Louisville 4, Kentucky.

1000 BUSINESS Cards $2.50 Prepaid. Samples free. Reliable Print Shop, 905 East Jefferson, Louisville 6, Ky.

500 3/4 x 2 1/2 PRINTED stickers 50c. 500 2 x 3 Two Color Shipping Labels $2.25. General Printing, Willis Myers Company, Owosso, Michigan.

MIMEOGRAPHING; Free samples! Topical Empire, 1527 Highland, Box 42 B, Louisville 4, Kentucky.

ECONOMICAL printing, state requirements. Odom Supply, Box 9345, Tampa, Fla.

QUALITY Printing—Low prices—Complete line. Everything prepaid. Price list free. Albert Wilcox, Nicholls, Georgia.

1000 BUSINESS Cards $1.75; 500—$1.35 Prepaid. S&W Printing Co., 32 Grand Street, New York City.

82 PATENT ATTORNEYS

PATENT practice before U. S. Patent Office. Validity and infringement investigations and opinions. Booklet and form "Evidence of Conception" forwarded upon request. Lancaster, Allwine & Rommel, Registered Patent Attorneys, Suite 412, 815—15th St. N.W., Washington 5, D. C.

C. A. Snow & Co.—S-427. Snow Building, Washington 1, D. C. Registered Patent Attorneys. Free Information.

PATENTS—Trade Marks. Patent Lawyer, Gustave Miller, 30-B Warner Building, Washington 4, D. C.

REGISTERED Patent Attorney offers services. Sanders, 6430 Evans, Chicago 37, Illinois.

INVENTORS: Without obligation, write for information explaining the steps you should take to secure a Patent. John N. Randolph, Registered Patent Attorney, 209 Columbian Bldg., Washington 1, D. C.

INVENTORS: Learn how to protect your invention. Unless the inventor is familiar with patent matters, he should engage a competent registered patent attorney or agent to represent him. We are registered to practice before the U. S. Patent Office and prepared to serve you in handling your patent matters. "Suggestions Guide for the Inventor" containing detailed information concerning patent protection and procedure with "Record of Invention" form will be forwarded to you upon request—without obligation. Clarence A. O'Brien & Harvey B. Jacobson, Registered Patent Attorneys, 02B-A District National Building, Washington, D. C.

INVENTORS: When you are satisfied that you have conceived something of value write me, without obligation, for information as to what steps you should take to secure a Patent. Write Richard D. Beavers (Formerly Randolph & Beavers) Registered Patent Atty., 938 Columbian Bldg., Washington 1, D. C.

INVENTOR'S Guide free on request. Frank Ledermann, Registered Patent Attorney, 154 Nassau St., New York 7.

INVENTORS: Write for free brochure "Evidence of Invention." Labiner, World Building, New York 7.

INVENTORS—If you believe you have an invention, you should disclose it to me to protect it. The firm of McMorrow, Berman & Davidson with offices in Washington, D. C., is qualified to take the necessary steps for you. Send for copy of our Patent Booklet "How to Protect Your Invention." We will also send the "Invention Record" form. No obligation. They are yours for the asking. McMorrow, Berman & Davidson, Registered Patent Attorneys, 143-R Victor Building, Washington 1, D. C.

INVENTORS—If you consider your invention to be something of importance, take steps to protect it with a United States Patent which gives you the right to exclude others from making, using and selling your invention as claimed. "Patent Protection for Inventors" outlines steps to take to secure patent protection. Mailed promptly without obligation. Mailed Evans Co., Merlin M. Evans, Registered Patent Attorney, 541-C Merlin Building, Washington 6, D. C.

PATENTS—Trade marks. Irving L. McCathran, 316 McLachlen Bldg., Washington 1, D. C. Registered Patent Attorney.

PATENTS. "Proof of Invention" folder mailed without obligation. E. E. Vroman, Registered Patent Attorney, 512 McKim Bldg., Washington 5, D. C.

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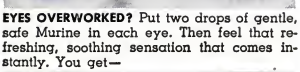

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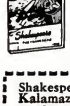

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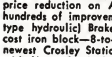

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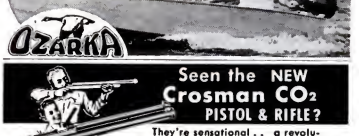

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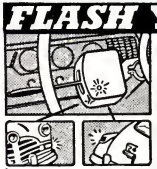

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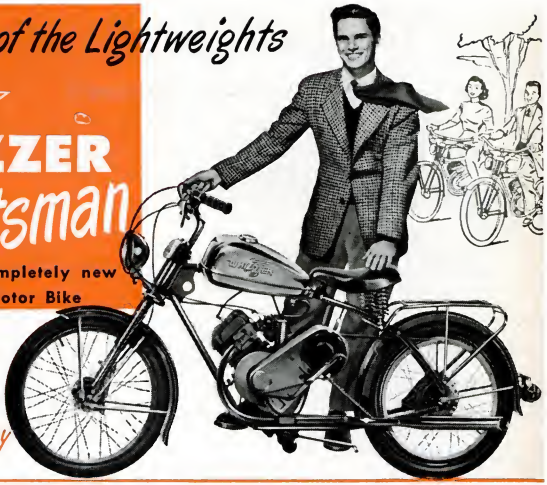

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PS
The Voice of Science

What Happened to Atomic Secrecy?

IT WAS no surprise to the scientists that the Russians got the bomb. The men who split the atom had long warned that *the basic science* from which came nuclear fission could not be kept secret.

The engineering know-how could be cut up into tons of tables and blueprints, and hidden in the crannies of a thousand minds. But the "secret" could no more be bundled up and locked in a safe than the wind could be held in the hand.

For a time the scientists hoped, with everyone else, that the sheer quantity of know-how and money could buy delay. Yet again they warned that our ways were not the only methods to manufacture hell on earth.

Then came the whirlwind of threatened horror already nicknamed the "H-bomb." Locked doors and armed guards could not stop the talk. Even while it could not be officially admitted, it could not be denied.

Who blabbed? Nobody. The facts of science were on the record.

Only five or six years ago, anyone who said "atom" out loud was in trouble. This time, the even bigger "secret" burst into print. Speculation—scientific, political, and moral—reaches new heights, complete with learned comments by columnists and cutaway drawings. Here we go again!

But let's not go through the whole routine of "just another weapon." Let's not kid ourselves again by saying, "Ah, but we've got the secret of the *Hydrogen* bomb!"

In the present low state of the world, we will have to get into the H-bomb business. But let's not maintain the slowdown of secrecy. Let's admit the only *real* secret we've got is the secret of the soap business and the automobile business: how to make *more* of them *quicker* and *cheaper* than the competition.

Maybe enough murderous weapons that guarantee suicide will stop the shooting and start the thinking.

Perry Gilkey

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packed with value and ready to prove it!

Here's the sensational new standard for excellence in the low-priced car field—the brilliant new, value-packed Plymouth!

No other car at the price gives you anything like the new Plymouth's great engineering advantages. The speed and ease of Ignition Key starting . . . the thrilling performance of the 7.0 to 1 high compression engine . . . the swift, smooth stops of big Safe-Guard Hydraulic Brakes . . . the positive blowout protection of Safety-Rim Wheels.

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Smart 1950 buy—this Studebaker's thrift and value!

JUST a look at the low, long, alluring new 1950 Studebaker tells you that it's a car with the right build for real money saving.

You see no bulging excess bulk that would hitch a ride at your expense—no surplus poundage to squander your gasoline needlessly.

You get welcome protection against unexpected repair bills, too.

The whole structure of this refreshingly different new car has the solid durability of top-quality materials and wear-resisting craftsmanship.

Take the logical next step in getting the most for your new-car money.

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Stop in at a nearby Studebaker dealer's showroom and go out for a convincing drive in a low-price Champion—a value-packed Commander—a special extra-long-wheelbase Land Cruiser.

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White sidewall tires and wheel trim rings optional at extra cost

You ride in deep-bedded comfort—New balance of design and a brand new kind of coil spring front-end suspension! Regal de luxe Champion has foam rubber seat cushioning.

You're money ahead on gas with a 1950 Studebaker because it has trim, sleek, aerodynamic lines—and the whole car has the right build for thrift in every detail of its structure.

You don't roll back on upgrades—Automatic hill holder is standard on Commanders and Land Cruisers—extra cost on Champions. Overdrive is available too at extra cost.

You get trustworthy craftsmanship that's the pride of numerous Studebaker father and son teams. It's your assurance of top trade-in value.

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POPULAR SCIENCE
REG. U. S. PAT. OFF. Monthly

Punctured cloud . . . Here's how a man-made hole in a cloud looks from topside, 15,000 feet up. The racetrack-shaped opening, 20 miles long on the sides, five miles across on the ends, was formed by seeding a stratus cloud with dry ice. The ice acts as a trigger on the supercooled water droplets in the cloud. They condense into snow or sleet, fall out of the cloud and, bingo, there's a hole. The cloudbusting is part of Project Cirrus, a joint research program of the Army Signal Corps and the Office of Naval Research. Drs. Irving Langmuir and Vincent J. Schaefer, of General Electric, who originated the seeding technique, insist it can make rain. The Army and Navy, interested in military applications, just won't say.

How Good Is Our Anti-

Cover by Ray Quigley

"The importance of undersea warfare from our standpoint as a nation is fully as great as that of air warfare. . . . the scales have recently tipped in favor of the attack as far as undersea warfare is concerned."

—**VANNEVAR BUSH,** in *Modern Arms and Free Men*

By Phil Gustafson

Drawings by Ray Quigley

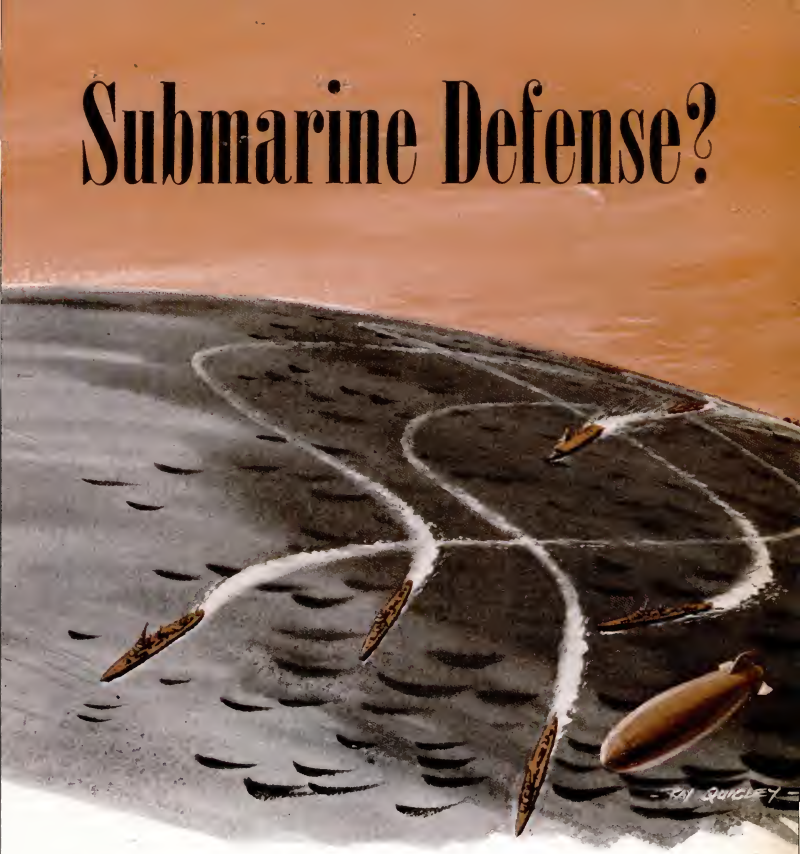
YOU are standing on the cramped bridge of a light carrier. Crowded around you are the Skipper, the watch officers, talkers, air officers, the Admiral commanding this Hunter-Killer Force, and some of his staff.

On the flight deck, a couple of narrow ladders below you, plane pushers are respotting aircraft at once familiar and strange: torpedo-bombers like the faithful old Grummans, but looking like bullfrogs with grossly swollen housings for search gear.

Down another ladder, men in the constant twilight of the information center watch their scopes and plot their dope. Topside, it is a bright tropical day, but your eyes are heavy from the strain of round-the-clock operations. In ASW—Anti-Submarine Warfare—the hounds share the nerve-wracking jumpiness of the fox.

Off the beams and the bows, the destroy-

Submarine Defense?

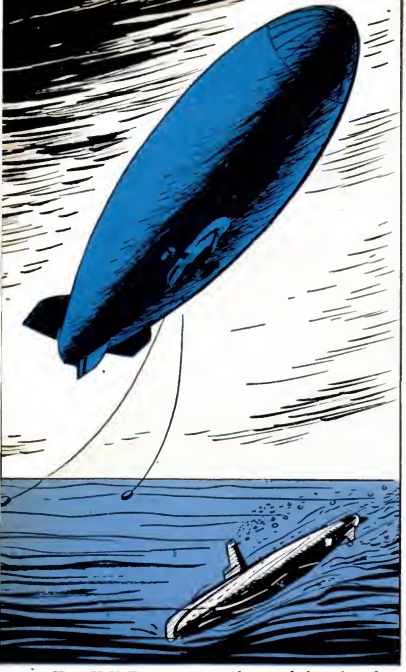


A radar-nosed, long-range Martin patrol bomber, left, meets a Hunter-Killer Force at sea.

ers weave their wakes. Overhead, planes drone across, flags whip in the wind, the radar rotates monotonously. And under you, somewhere in all that water, is an "enemy" submarine. A modern submarine, equipped with the batteries to shove it along under water about as fast as you can go on the surface. With a snorkel to let it breathe for recharging without surfacing.

At your elbow, a squawk box begins to blat. One of the search planes, patterning the endless ocean, has caught a scent. A blimp swoops over to investigate with surprising agility: 70 knots is very fast a few feet off the water. Then comes the call for a killer, and a destroyer closes in like a cowboy. Up comes the sub, a sleek steel shark, and you realize how near it was to getting your carrier, nerve center and home base of the whole H-K force.

That's the way it is in the maneuvers—sometimes. The deadly guppy-snork *can* be caught and killed—when weather and water favor the hunter-killers. But find-



How H-K Force works: Ship- and shore-based planes and blimps, sweeping with radar, have outlined suspicious waters and forced subs down. Here, a carrier-based blimp fine-combs the sea with radar, sonar, and magnetic-detection equipment. Flying slowly and close to water, blimp puts the finger on a submerged "target."

ing and fighting the modern submarine is as difficult as it is important in the face of the facts.

ASW is as darkly secret a business as the deep, black sea itself. Security is as tight as a sub rigged for dive. But it is a very public secret that:

1) ship for ship, in the brutal economics of undersea warfare the odds are again with the subs;

2) the latest German subs could have operated successfully against the detection and killing devices that had swept the old types from the seas;

3) the latest German torpedoes had range and speed beyond the capacity of detection equipment; and

4) Russia thus has the makings of a potent undersea navy.

The modern submarine (PS, June '49, p. 98) can travel far, lug missiles and maybe A-bombs. Dr. Vannevar Bush calls it "one of our greatest potential enemies" because it can "cut the world apart." The Navy knows it as a devil's wager at such unhappy odds in men, money, and materiel that it cannot be won head-on.

So it is proper to ask, "How good is our anti-sub defense?"

The honest answer to this simple question is not simple. It is big and complicated. It might be fairly summarized, as of now, by saying, "only fairly good—but getting better."

That represents an improvement. A while back, the answer could have been a grim, "Oh, brother!" Today there is not only a new *attitude* toward the importance of the problem in the Pentagon. In the Navy itself, there is a *broader approach*, planned to draw on the best in civilian science as well as operational experience.

Of course, you should know that to ask, "How good is our anti-sub defense?" is a little like asking, "How much is an automobile?" The answer must carry such question marks as, "How much automobile, and how much money?"

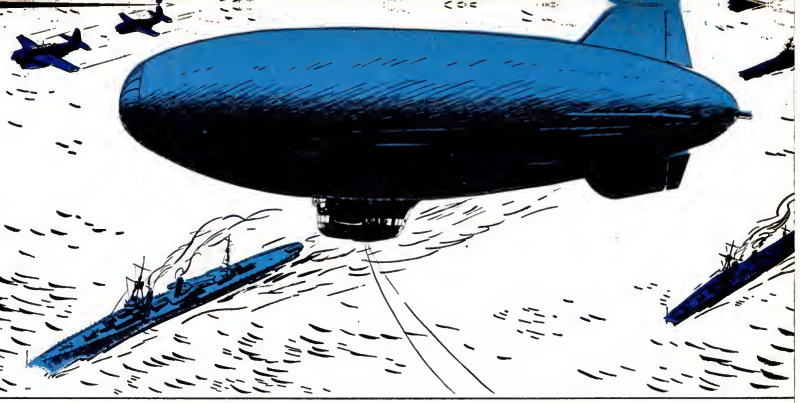
What Will You Pay for a Dead Sub?

Want to kill a submarine? Sure! Can do. But how much are you willing to spend? Want to swap a carrier with 700 men for a sub with 70? Remember that a sub can bite, too. In fact, today's torpedoes go so far so fast that *the first anti-sub alarm might be a sinking ship.*

Killing the sub, furthermore, is just part of ASW. It begins, like the recipe for hunter's stew, with, "First catch your rabbit . . ."

Today's sub-hunting still centers around the nervy little Hunter-Killer Force that broomed the seas in World War II. It is composed of a carrier, several destroyers, and assorted aircraft.

The carrier is not the tin jeep used for ASW in the war, but a tougher, faster flat-top. The kind they first adapted from tanker hulls, like the *Mindoro, Siboney,* and *Sicily.* Or it may be on a cruiser hull, like the *Saipan.* Whatever the hull, it is stripped and streamlined for speed, with



Yelling for the Hunter-Killer ships and planes, the blimp fences the suspect seas with sonobuoys and marks the general position of the deep-speeding guppy. Hunter destroyers take up the chase with sonar, and pin-point the target. Telltale "pings" of sonar warn the sub that the hounds are hot on his trail. He twists and dives to keep the upcoming killers from drawing a bead—which in war would lead to a shower of deadly depth charges.

a Combat Information Center specialized for sub-hunting and fighting, and the latest thing in radar.

The destroyers are faster and lighter on their feet. Off with some topside armament; on with aluminum superstructure to cut weight. New hunter and killer DDs are being built from scratch, led off by the *Carpenter* and the *Owens*.The light cruiser *Norfolk* has been converted into the first HK of cruiser size and speed. These are the specialized snorkel hounds.

The aircraft, too, are becoming more specialized. Some have the emphasis on search; others on weapons for killing. TBMs and Douglas Skyraiders, bloated with radar or bristling with rockets, depth charges, and torpedoes, are carrier-based.

Often the HK Force may collaborate with such land-based, long-search big planes as the P2V Neptune. A possible new helper may be the Martin P5M-1, the heavy-hulled flying boat designed for ASW operation. A legitimate guess is that this aircraft would be able to squat on the wet almost anywhere and listen for subs.

The pack closes in. Killer ships—destroyers with extra weapons and speed—maneuver to bring their deadly hedgehogs to bear with sonar targeting gear. Killer planes drop homing torpedoes and circle to fire rockets if sub surfaces. The blimps stand clear. The carrier zigzags warily into the background: the H-K Force cannot afford to swap a carrier for even the most dangerous sub. Finally, a special weapon or a hedgehog missile connects. Sonar plot reports the under-noise of a hit. The surface breaks in a widening boil: "Heard sub; sank same."

The blimps have a bigger job in the Hunter-Killer Force (PS, July '49, p. 124). Now carrier-based, they can fly out with full detection equipment to extend the fleet's ears. And fly low and slow enough to use fine-tooth search gear at peak efficiency.

The helicopter is a logical candidate for HK membership. It might be used for fine-combing much like the blimps. And its ability to hover could come in handy for putting down advance listening posts.

The anti-sub sub (SSK) is one of the best shots in the Navy's ASW locker. You can set a sub to catch a sub quite successfully, as proved by the record of Jap subs sunk by ours. A sub quietly listening can hear farther than a moving enemy sub

Douglas Skyraider (AD3W) is carrier-based search plane. The huge plastic radome underneath houses the radar antenna. Possibly teamed up with specialized killer plane with emphasis on weapons.

whose speed clouds his own sonar. Our new guppies are getting high-power detection equipment to let them go on the prowl. And new killer subs are being built. But the SSK will hardly dare work too intimately with the HK force until somebody finds a way for a friendly sub to identify itself without exposing itself. With no way to yell, "Don't shoot, Joe, it's me!" the SSK will have to keep away from the local area of the Hunter-Killers.

These are the craft the Navy uses—under, on, and over the sea—to find and fight the new-type subs that have changed the shape of undersea warfare. The German Type 21, you remember, had at least doubled the eight-to-ten knot submerged speed of the old subs. This meant it could make more than one swift pass at a convoy, or walk away from hunters that had to slow down to hear better. The German 45-knot torpedo could be fired from five or six miles, far beyond sonar range under the best conditions even today. So what about sonar?

Sonar equipment comes in two main types: what might be called "passive" sonar, which simply *listens* for underwater noise and indicates direction; and "active" sonar, which sends out a supersonic pulse called a "ping." The ping bounces off a target much like radar, and the newest type presents information on a screen.

Since sonar protection is outranged by existing torpedoes, the Navy has met the problem differently. As Rear Admiral C. B. Momsen, head of the working party whose chore it has been to plan undersea warfare, puts it:

"If we cannot project our *detection* out to the new torpedo range, then we must project the *platform*, just as the airplane projected the gun platform."

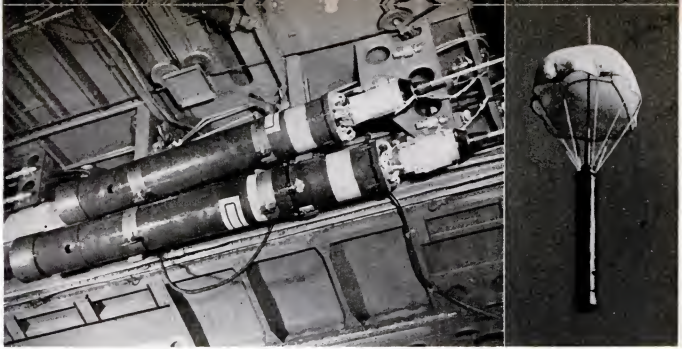
The platform from which detection works can be pushed out with the sonobuoy, the blimp, probably the helicopter, and the anti-sub sub that can range discreetly ahead of the Hunter-Killers as a forward listening post.

Buoy Buggy Whip Blabs on Subs

The sonobuoy is an expendable, battery-powered baby broadcasting station. Dropped into suspect waters by plane or blimp, it lowers a microphone, snaps up a little buggy-whip antenna, and blabs what it hears. Monitored by aircraft, a pattern of sonobuoys can keep a sub under surveillance until surface craft can carry on the chase with sonar.

Pinging sonar is the most accurate close-in detection method. The trouble is that it's too close. But the blimp promises a valuable projection of the platform. The blimp also carries another detection gimmick: MAD—Magnetic Airborne Detection—that can point the finger at a submerged sub by its distortion of the earth's magnetic field.

MAD gear is still pretty delicate laboratory equipment to be tossed around in mid-air, but it works when it works. During the war, it was the only detection gear that could smell a German sub trying to float with the tide, quietly submerged, through



Sonobuoys are simply floating radio stations the size of fence posts. Parachuted into the water, they let down a listening hydrophone, pop up an antenna, and broadcast what they hear under water. Dropped in a definite order to ring an area where enemy submarine activity is suspected or to protect an operational zone, sonobuoys identify their positions by their individual transmission frequencies. Dye markers, spotting the buoys in the water, show aircraft patrolling a sonobuoy fence in daylight where there are any gaps that must be plugged up.

the Straits of Gibraltar. A sharp eye can see the MAD "birds" perched forward on the bag of a blimp, like ears.

The sub-hunters also rely heavily on radar. Improved models in ships and aircraft can catch even the small target of a snorkel. A snorkeling sub presumably has its radar detector going, too, so the very presence of ship and airborne radar over an area is a fine way to keep the subs down or out.

These are the main detection devices that can find the elusive and powerful new subs. But once you've scented your rabbit (and remember, it's a man-eating rabbit!) how do you kill it?

The "hedgehog"—so named in wartime code for its many deadly bristles—is one of your weapons. Once a sub has been pinpointed by search, and pinned down by killer planes, the destroyers can start shooting with hedgehogs.

Hunting with Rocket Shotguns

These forward-throwing weapons shoot a shotgun pattern of rocket-propelled charges ahead of or alongside the killer ship while it still has the running fox on sonar plotting. The many high-powered charges sink swiftly, and when one hits a sub it hits hard. If you know your weapons, you can wonder about the possibility of more and bigger hedgehog projectiles fixed up with noses like a VT fuse (see cover).

The acoustical torpedo, fitted with homing nose, is known to have existed.

Hedgehog is multiple-projectile weapon, firing many contact charges simultaneously, ahead of killer ship making sonar attack on sub. The rocket bombs, shown here on spigots, are set at slightly different angles so that they land in a pattern like shotgun pellets.

"MAD ears" are high and forward (arrows) on gas bag of blimp. Working just off the water at any speed from a slow swim to double a destroyer's best, blimps can use several kinds of detection gear effectively, since the streamlined guppy-snork submarines have no deck guns with which to shoot them down.

Released by destroyer, aircraft, or SSK, it avoids its friends by a pressure switch set to explode it only between a predetermined underwater floor and ceiling.

Airborne rockets, with a solid steel head that can slam through one side of a sub and out the other, can take care of any guppy-snork that might have to surface.

Even with all this search and shooting gear, the Hunter-Killer Force is not likely to be the final answer to the ASW phase of undersea warfare. It risks so much in that "devil's wager." A carrier, at least six destroyers, two to four blimps (too far from shore to fly home if their carrier goes down), maybe 20 or 30 airplanes also dependent on the carrier.

More and more, shore-based planes and tough new seaplanes will probably take up the task of general search-and-kill. The Hunter-Killer Force, however, will have to take on the risky job of guarding the big, slow convoys that must always move the huge supplies for global war.

One hard conclusion is visible: no single gadget like sonar, which made us overconfident at the outset of World War II, will again be the obvious answer to ASW. From now on, our anti-sub defense depends on broad development rather than simple discovery.

Killing Only Part of Problem

In this process, constant and continuing, the actual hunting and killing of the modern submarine becomes only one part of the total problem. Also involved are the survey and selection of convoy routes where weather and water conditions are more favorable to the hunters than to the subs. Any future ASW operations must take the offensive by mining the waters enemy subs must use, and by blasting the sub pens and construction yards.

Even such seemingly extraneous factors as our own cargo-ship construction must be taken into account. You might ask yourself why cargo ships should carry masts and booms and donkey engines for loading, when more modern materials-handling equipment is already available. Stripping off such cumbersome gear would lighten and speed up ships. And cutting down turnaround time would be the quick equivalent of a vastly larger merchant marine. Dockside cranes and loading of whole freight cars, lifted bodily from their wheels, would create more shipping space overnight than could be constructed in many weeks—or sunk by an enemy in a frightful fraction of construction time.

This is only a flash of the total scope of the problem of getting a lot of tonnage across a lot of water. Direct huntin', shootin' anti-sub defense will of course continue as a part of the deal, calling for the best scientific and military thinking in the nation. Warns Dr. Bush. "We need a vigorous program in the hands of a virile and generously supported Navy, in closest cooperation with science and technology throughout the nation."

Thinking Must Come Before Fighting

As evidence of its own grasp of the situation, the Navy recently called in Vice Admiral Francis S. Low, ASW chief in World War II, to evaluate needs. There's now talk of a new committee of working scientists to project the *thinking* platform.

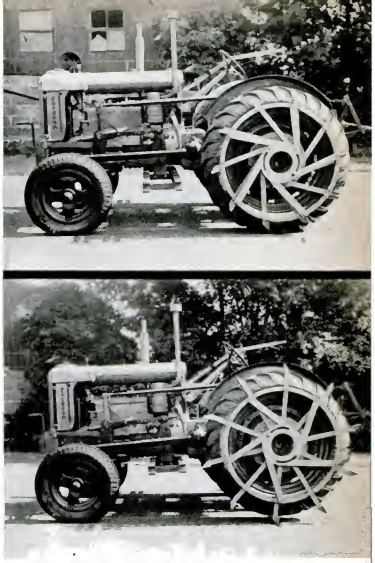
As an example of what is needed in the dreaming stage of detection equipment, consider the single problem of thinking out sonar equipment that will mechanize the *peak* performance of the *best* human operators. The way things stand now, even the best operator is wearied by the monotony of listening to the sweeping pings to the point where he loses his sense of audio-discrimination, and may make a fatal mistake.

For the sub-hunters, as well as the submariners, must now lean most heavily on the human factor. And as one ASW expert puts it, "Any future undersea war may be won by the nation with the most rugged musicians." END

They're aviation mechanics. The speaker means he found one of the ribs in a wing broken when he removed the fabric covering.

Stilts Boost Tractor's Grip

THE spoked attachment mounted on the rear wheel of the tractor in the photos at right is a British device for giving the tires greater traction when needed. When two nuts at the hub are loosened and the tractor driven forward, 10 spokes are thrust outward to project beyond the tire, as shown in lower photo, becoming ground grippers. Tightening the nuts locks them in position. To retract the cleats, the nuts are loosened, and the tractor backed up. Stanhay Ltd., of Ashford, Kent, England, is the maker.



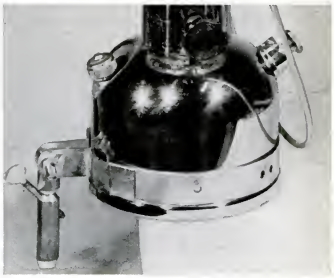
Like the leaves in a camera iris diaphragm, the lugs on the wheel expand or retract with a partial turn of the hub plate. Models are made to fit most U. S. and British farm tractors.

Tape Has Tarzan Strength

A SINGLE, inch-wide strand of a new tape is holding up these three barrels of oil weighing almost 500 pounds. Similar in appearance to Scotch tape®, the new product is made of acetate film. Its tensile strength of 500 pounds for each inch of width is gained from thousands of continuous glass fibers embedded lengthwise in an adhesive backing. The inset shows a roll of the new tape, which comes in 72-yard lengths, and in standard widths of ½, ¾, and 1 inch. Minnesota Mining and Mfg. Co., makes it.

Lantern Plugs into Oarlock

HERE'S a boon to night fishermen—an aluminum bracket that clamps around a lantern base, as shown below, with a finger that fits the oarlock socket of a rowboat. A thumbscrew holds it fast. When the lantern is used on flat surfaces the finger can be folded up. Made by Timcor, Inc., Cleveland, the bracket fits all gasoline lanterns.



Health Clinic Takes to Road

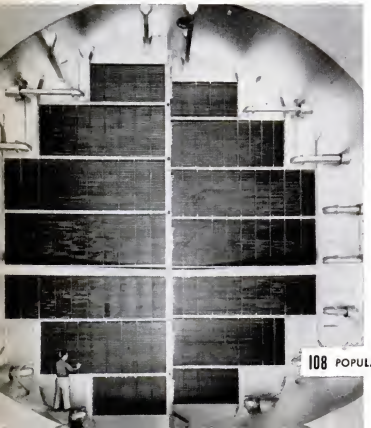
This special coach is one of 10 clinics on wheels that will bring modern medical and dental facilities to remote rural regions of Cuba. The trailer houses a motor-generator to power the medical equipment. Built by the Linn Division of Great American Industries, the units each contain complete X-ray apparatus, a darkroom, a dental office (shown at left), and a clinical laboratory. A team of six physicians, dentists, and technicians mans each unit and has living quarters in another coach.

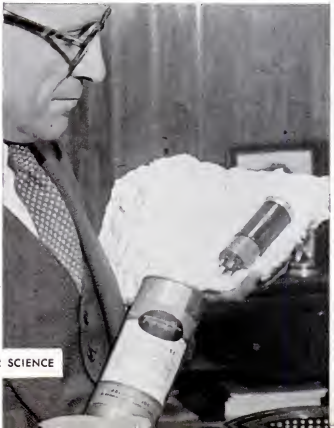
Giant Radiator Cools Big Wind

When more than a million and a half cubic feet of air are blasted through a 6- by 6-foot wind tunnel at 1,500 miles an hour, the inside gets mighty hot. That's the reason for this huge radiator (below) at the Ames Aeronautical Laboratory, Moffett Field, Calif. Through its 10 miles of bronze tubing circulate some 10,200 gallons of water every minute. With its fins, it has nearly 117,000 square feet of cooling surface. The man gives an idea of its size.

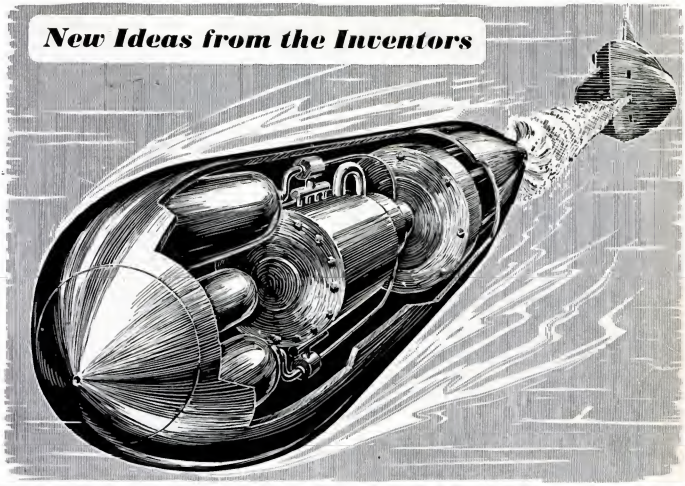
Tin Can Protects Geiger Tube

Safe shipping is assured the sensitive tubes that are the heart of Geiger counters when they are packaged in a new tin can developed by the American Can Co. The tube is first wrapped in cotton batting, as shown below, and then placed in the can, which is hermetically sealed. This not only protects the tube from rough handling, but, since the can is airtight, keeps its thin mica window from being affected by pressure changes during shipments by air.

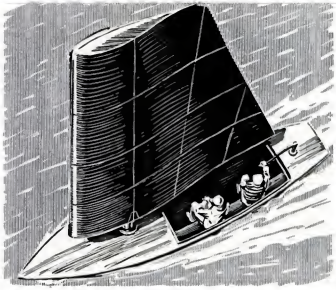




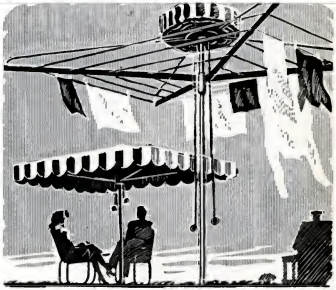
New Ideas from the Inventors



1 Steam to Drive Torpedo. Steam generated by the heat of chemical reactions would power a turbine to drive this naval torpedo. Hydrochloric acid and water are fed into a reaction boiler containing pellets of magnesium. Both the acid and the water react with the magnesium, producing heat that vaporizes additional water to form steam. The steam in turn drives a turbine connected to the propeller shaft.

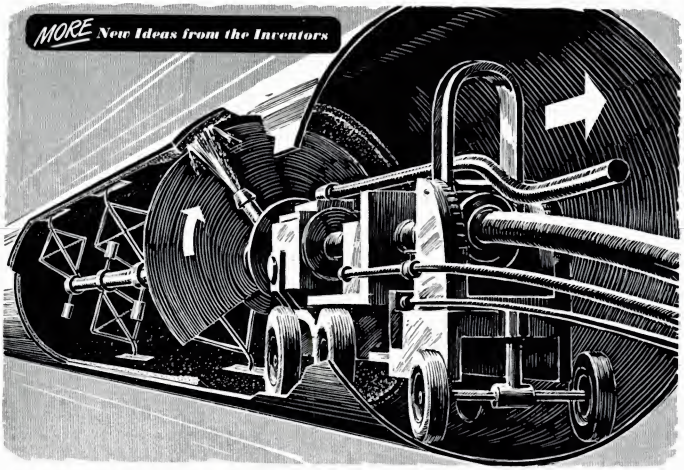


2 Rigid Sail to Propel Boat. This rigid sail shaped like an airplane wing is designed to give a sailboat the more efficient aerodynamic characteristics of a true airfoil. Being rigid, it also eliminates "flutter" and provides greater area. The trailing edge is flexible and can be turned to change the airfoil shape as desired.

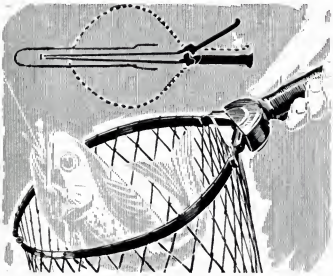


3 Drier to Shade Terrace. This back-yard clothes drier could also double as a king-size garden umbrella. A canopy fastened by means of rings to four rods on top of the drier arms is controlled by two pull cords. Pulling one cord lowers the canopy down over the drier frame; pulling the other cord folds the canopy back up.

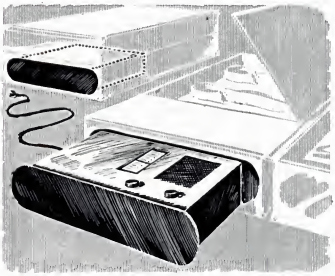
Turn the page, please, for three more new ideas



4 Machine to Line Pipes. Large pipes for liquids could easily be given a protective lining with this robot sprayer. It not only sprays on the coating as it progresses through the pipe, but smoothes it to just the right thickness with a series of rotating trowels. An electric motor drives the robot's wheels and rotates the spray nozzle. Power is supplied by a cable; the mixture and compressed air are fed through hoses.

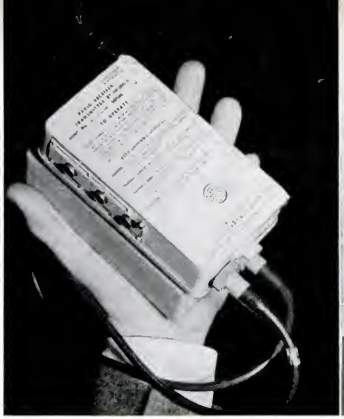


5 Net to Close on Fish. That big one couldn't get away once you bagged him in this hand net. Releasing a lever on the handle causes the spring-steel loop supporting the net to collapse flat, closing over the fish. When not in use, the closed net can be stowed in a scabbard fastened to an angler's belt.



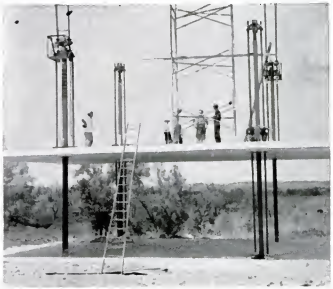
6 Suitcase to Hold Radio. A traveler who likes a radio would always have a portable with him when he carried this suitcase. An AC-DC radio pulls out of a compartment in the side of the bag like a drawer. Its antenna is concealed in the dividing board that separates the bag's two clothes compartments.

Patents on these inventions have been granted to: 1. E. Gulbransen, Pittsburgh, Pa.; 2. W. Carl, Jr., Hampton, Va.; 3. H. Lewis, Los Angeles, Calif.; 4. J. Crom, Washington, D. C.; 5. A. Crot, Topango, Calif.; 6. A. Olson, Niles, Ill.



Rescue Radio Fits Pocket

SURVIVORS of a ditched bomber who recently drifted in the ocean for 79 hours might have been rescued in two hours if they'd had the new miniature transmitter-receiver illustrated above, according to the Air Force. Hardly larger than an emergency ration kit, the radio consists of a transmitter-receiver and a mercury-type battery that slips into the pocket of a flying suit. It operates on both very-high and ultra-high frequencies, and its messages can be picked up at a distance of 80 miles. Soon to become standard equipment, the new air-sea rescue radio will replace the older "Gibson Girl" that weighs 40 pounds, operates on medium frequency, and requires yards of antenna that must be lifted up into the air by a kite or balloon.



Raising Roof Speeds Building

A REVOLUTIONARY new construction technique consists of casting roof and floor slabs over the ground floor and then raising them to their permanent positions with automatic lifting equipment. Called the Youtz-Slick method, it was developed at the Institute of Inventive Research, San Antonio, Texas. In the photo above, a concrete slab that was poured on the foundation over a separating medium has been raised on columns.

Wood Chopped to Mulch

GOOD farmers may not burn brush or fruit-tree prunings any more. They'll chop it up and use it for bedding or mulch, returning valuable organic material to the soil.

The machine above, custom-built for the U. S. Soil Conservation Service by the Fitchburg Engineering Corp., Fitchburg, Mass., has four blades that make 900 strokes a minute. It cuts limbs up to six inches in diameter and sprays the chips on the soil.

"Unstable Mabel," Tiniest Glider, Hits 250 M.P.H.

Vest-pocket glider Unstable Mabel flies over rugged terrain of California's Lucerne Valley.

War veteran thrills air-show crowds by stunting sturdy 305-pound craft patterned on supersonic rocket plane.

By Andrew R. Boone

A TINY, stunting glider that looks like—and, in fact, was modeled after—the first U. S. airplane to fly faster than sound is the latest addition to the air-show business. Piloted by Roy Cusick, a 52-year-old veteran of the wartime Ferry Command, it builds up far higher speeds than most gliders will stand. In a dive Cusick's speed often hits 250 m.p.h. He says the wing of his 305-lb. craft, dubbed Unstable Mabel, is strong enough to take 400 m.p.h.

Towed aloft by plane, Cusick cuts loose at an altitude of several thousand feet to loop, roll, and do fast pull-outs. During the past winter he practiced Immelman turns for introduction at this year's shows. That's a half-loop, half-roll maneuver devised by a German in World War I for quick reversal of direction. Cusick's practice area is California desert air. He lands on dry-lake beds.

Unstable Mabel is one of the few gliders that have ever been towed all the way across the continent. Cusick had a close call on that trip. He was scheduled to stunt his glider over Long Island, N. Y., and gave himself nine days to make the tow. Unstable Mabel sailed along nicely at the end of a 600-foot nylon rope attached to a 450-hp. biplane until she was four miles east of El Paso. There, the rope, frayed by scuffing during a cross-wind take-off, parted. Cusick had only 500 feet of altitude. Almost as bad, the wind was directly on his tail. He had to make a 180° turn to land against it. Whipping around, he put his wheels on a winding dirt road, slipped between two cuts in among some sand dunes, and rolled down a gentle slope into a gravel pit. Not so much as a scratch on the plane marred his landing. Unstable Mabel was on hand

Wearing 'chute, Mabel's 125-lb. pilot enters cockpit, which is only 20 in. wide at shoulders.

for her performance in the east three hours before show time.

Mabel is well-named. She comes in hot, and occasionally Cusick has to make a change in her to temper her behavior. Once he found himself in an accidental snap roll. He cured that tendency by installing small blisters under the leading edges of the wingtips. That prevented the tips from losing their lift at critical moments.

Brackets for jet-assisted take-off have been designed for Mabel's wing. Cusick may use them at his 1950 shows.

Cusick patterned his glider after the X-1, the Bell supersonic rocket-driven plane. Its first sketch was drawn on a hangar floor and incorporated the X-1's pointed nose and fat fuselage.

Though Mabel is a tiny vehicle as flying machines go, Cusick wants one even smaller. He hopes to build a glider that, boosted by a ram-jet engine, will clip off 400 m.p.h. Its wing area would be a third less.

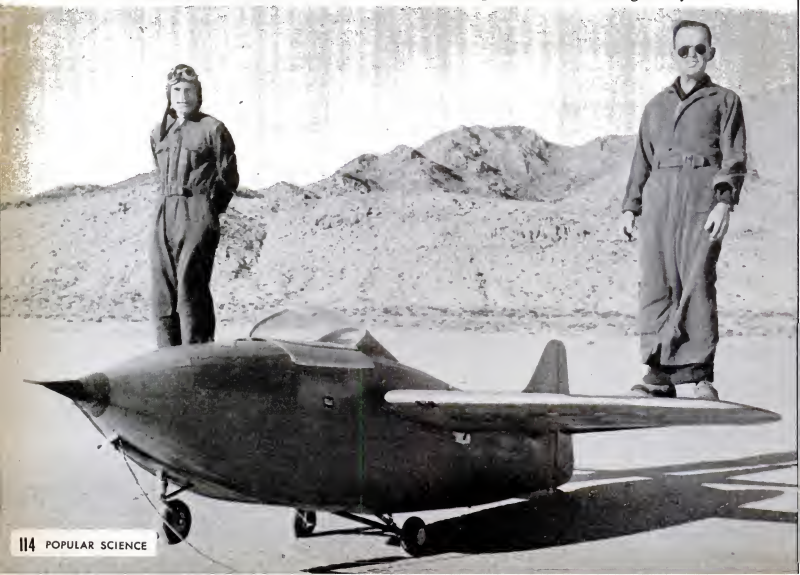
In cockpit, Cusick holds cardboard against plastic canopy with his head for protection against sun. Plane becomes airborne at 100 m.p.h. in take-off from field 6,850 feet high.

Mabel's wing and elevator support glider when it is stood up on edge. Used on powered plane, same wing once flew in National Air Races.

SPECIFICATIONS

WING AREA	43 SQ. FT.
SPAN	14 FT.
WING LOADING	10½ LB.
LENGTH	15½ FT.
HEIGHT	43 IN.
WEIGHT EMPTY	305 LB.
LANDING SPEED	70-90 M.P.H.
STALLING SPEED	60 M.P.H.
TOWING SPEED	85-105 M.P.H.

Wing strength is demonstrated by its support of two men weighing total of 300 lb. It is covered with 3/16-in. plywood. Photo was taken after 120-m.p.h. downwind landing on dry lake.



Steerable nose wheel can be retracted manually after take-off. Five-inch tires are normally used on airplane tail wheels. Mabel's pilot performs with air show called Hollywood Hawks.

Only small man can shoe-horn himself into cockpit. Four instruments provide all flight information: stall and air-speed indicators, altimeter, accelerometer to measure stresses.

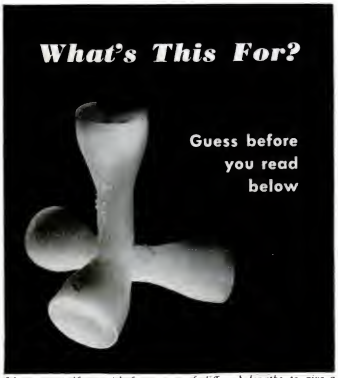
Manually operated flaps having area of 130 sq. in. slow glider down from normal cruising speed of 100 m.p.h. to 70 for landing. In stunting, glider loses height at 1,000 ft. per minute.

Unusually large tail group in relation to glider's size is necessary because aircraft is so short-coupled. During last winter, training flights were made from Big Bear City, Calif.

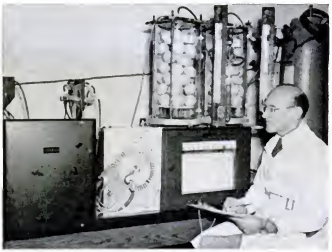
Head-on view of Unstable Mabel shows close resemblance to X-1. Needle-like projection from nose is pitot tube for speed indicator. Spring shock struts connect main wheels to main spar.

Service Sheds Shield B-36

ALTHOUGH the world's biggest bomber can fly in all kinds of weather, workers putting the finishing touches on a B-36 at Convair's Fort Worth plant are not immune to Texas temperatures and elements. Above are shown two all-weather service docks that enclose the three engines mounted on each wing of the huge Air Force bomber. Sixty feet long and 36 feet deep, they shade the workers from summer sun and can be heated to ward off winter chills. Photo at right shows a mobile dock rolled into place over a wing. A removable panel closes the front, protecting mechanics from wind, dust, and rain. Piped and wired for compressed air and electricity, the sheds need only be connected to an external outlet for complete construction facilities, including built-in floodlights. One type of dock will be of permanent construction to receive the bombers as they roll out of the factory; others will be mounted on dollies so that they can be moved from plane to plane as needed.

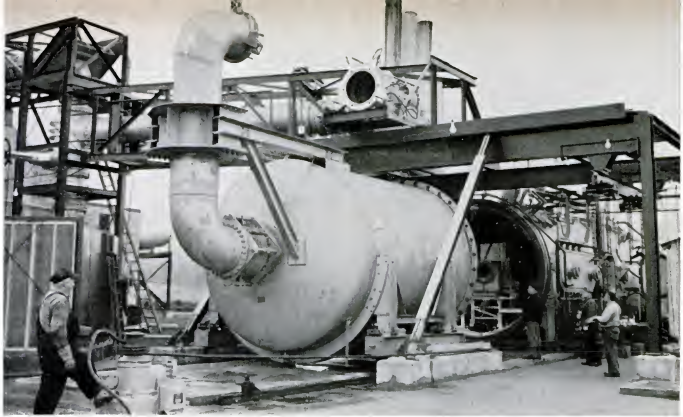


It's a new golf tee with four stems of different lengths to give a player a choice of heights. In any position, one stem stands vertically while the other three serve as tripod legs. Four-Up-Tee Co., of Mount Vernon, N. Y., makes it, in various colors, of a resilient plastic that won't damage club heads.



Breathe Deeply, Please

LEMONS, oranges, and grapefruit "breathe" like humans, taking in oxygen and giving off carbon dioxide. Using the oxygen analyzer above, Dr. Jacob Biale of the University of California at Los Angeles checks their respiration at different temperatures and in various gas mixtures. Results may show how to keep fruit longer in storage.



Capstan (left) pulls tank section on rails so that ram-jet engine can be installed for test.

Ram Jets "Fly" Inside Huge Tank

A BIG tank that splits in two now helps engineers design faster, higher-flying ram-jet engines. It tests the jets at "speeds" up to 2,600 m.p.h and "altitudes" up to 15 miles. The tank holds the engine, air-supply pipes and exhaust, and instruments. One section slides back so the engine can be put in. Giant fans blow the 2,600-m.p.h. wind, while steam jets vary exhaust-end pressure.

Since the noise of a smaller setup broke dishes eight miles away, the Wright Aeronautical Corp. engineers who designed this one were worried about its effect in thickly settled Wood-Ridge, N. J. So they floated the tank on springs on a 200-ton concrete slab six feet thick and provided 45-foot-high exhaust mufflers. It doesn't even shake the instruments next door. END

Engine under test is mounted just beyond flaring section of exhaust pipe (center) in big tank.

"Overhand Joe"

Clever mechanical pitchers

By Harold Rosenthal

HE ISN'T nearly as handsome as some of those matinee idols who fill the ball parks on Ladies' Day with shrieking, swooning females, but Overhand Joe has all the looks the nation's baseball magnates think he'll ever need. What's more, they don't have to slip him a staggering bonus to coax him to sign his initial contract, don't have to sweat through a yearly contract wrangle with him, don't get ulcers okaying fantastic meal checks for him, and don't have to worry about what he's doing after midnight.

Not Overhand Joe. That's because he's a machine, not a man—a pitching machine, the most popular developed in the history of the game. A weird-looking customer, he will be seen in a half-dozen major-league training camps this spring. He costs about $1,000, which is only a fifth of the first-year salary of the rawest rookie in the majors. And he'll pitch a dozen balls a minute, from sunrise to sunset, year after year and never complain of a sore arm.

Last year the Brooklyn Dodgers installed three batting-practice machines at Vero

Pitching machines at Brooklyn Dodgers' production-line training camp at Vero Beach, Fla., are literally a stone's throw from barracks where players eat and sleep. Shown in action there last year are "Iron Mike," at left, and early model of "Overhand Joe." They throw through openings in wire fencing that protects machines and operators from batted balls.

Reports for Spring Training

hurl strikes down the middle for big-league batters.

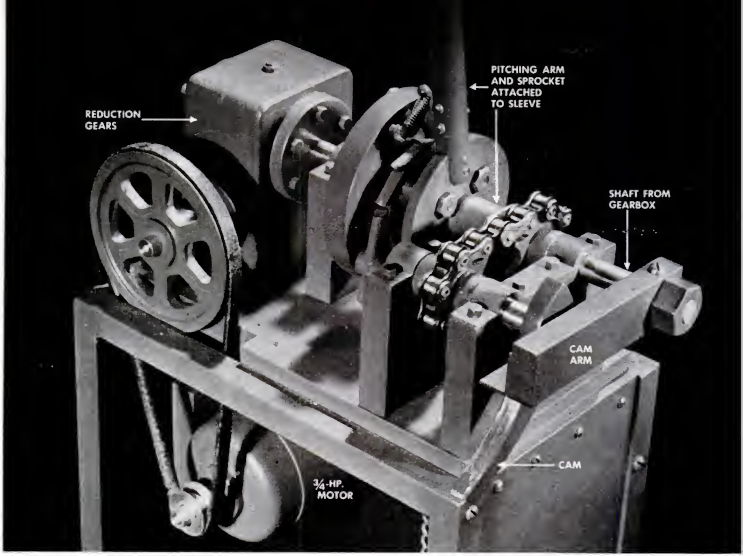
Beach—and won the National League pennant. Overhand Joe, a product of the Foster-Porter Enterprises, Inc., of Baltimore, caught the club's fancy. After the World Series, the club brought a machine to Ebbets Field for further experimentation. Out of it came a vastly improved model, of which eight have been sold to five major-league clubs. Meanwhile in Brooklyn's production-line training camp at Vero Beach Overhand Joe and two of his younger and newer brothers are tirelessly "getting them across" for the personnel of the Dodgers and their twenty-odd farm teams.

Pitching machines aren't new. As far back as the middle eighties there were attempts to get a batting pitch across by mechanical means. Just about every principle has been tried, from a bow-and-arrow contrivance to one operated by gunpowder.

Today there are three machines produced commercially. Overhand Joe whips a ball across off an arm traveling forward in a vertical arc; the Bazooka, another Foster-Porter development, fires the ball by compressed air; and Iron Mike, a St. Louis development, utilizes a claw and heavy-rubber-band arrangement. The Bazooka and Iron Mike have additional roles; they can also elevate their barrels and spray the outfield with a variety of long fly balls, keeping the fielders running around

Other training apparatus includes this pitching target to help hurlers correct early-spring wildness. Strike zone over home plate is outlined with white twine tied between two posts.

Gravity system for returning balls from outfield saves work for fly-chasers. Attendant gathers balls and drops them into pipeline back to pitching machine aimed high for long range.



How Overhand Joe burns 'em over is shown in these photos of PS-built model. Motor is belted to reduction gears, turning main shaft and cam arm at constant 11.6 r.p.m. Pitching arm, ratchet, and sprocket are mounted on a sleeve that fits free on this shaft. Here the cam arm, turning counterclockwise, has struck cam and is pulling it downward and backward.

until they trip over their own tongues.

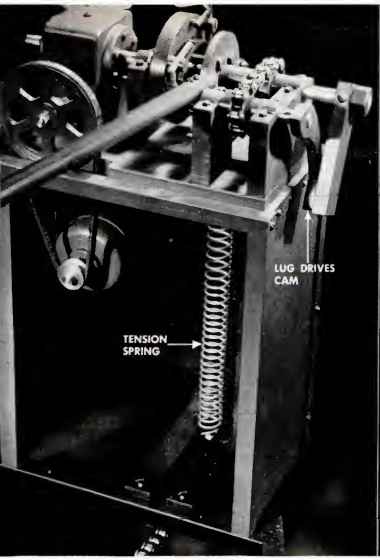
All of today's baseball machines require only one operator, and all can usually deliver a dozen pitches a minute. They are adjustable for speed, and can pitch for hours at a pace that would tear a top major leaguer's arm right out of its socket.

Ballplayers are super-enthusiastic about Overhand Joe. They say you can "see his pitch coming." His straight up-and-over motion is almost human and simulates the delivery of a number of major-league hurlers like Warren Spahn of the Braves and Ewell Blackwell of the Cincinnati Reds.

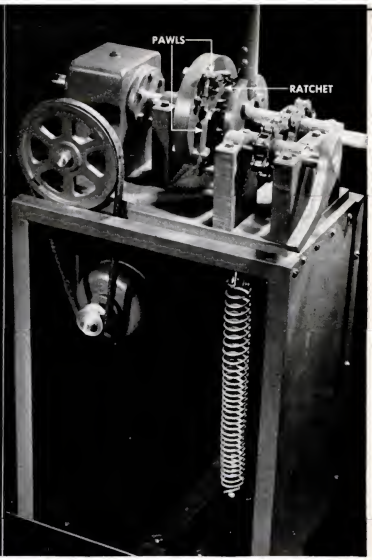
There is nothing complicated about Overhand Joe, not even his nickname. He has a long arm sticking up from an encased base. A ¾-hp. electric motor furnishes a complete cycle of operation at the rate of 11.6 a minute. Tension on a heavy spring determines the speed of the pitch and a V-shaped trough near the top of the throwing arm provides the spin for a "live" throw.

Of today's three commercial machines only Overhand Joe is not equipped to throw a curve. The Bazooka and Iron Mike can

Auto hitch in front allows 400-lb., rubber-tired machine to be towed anywhere. The leveling screw in front helps adjust trajectory of the pitches. This is latest production model.



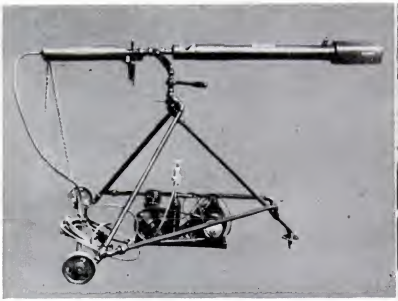
2 Pitching arm is drawn back by movement of cam. Chain linked to arm pulls tension spring underneath. Cam is about to slip off cam arm, letting spring whip pitching arm over.



3 Snapped over and then damped by re-applied spring tension, pitching arm is now kept from oscillating wildly as pawls on the main shaft engage ratchet secured to pitching arm.

Crank in back permits operator to vary the tension of the power spring. This adjusts speed of the pitches up to a maximum of 90 m.p.h. Machine can throw a pitch every five seconds.

Ball is placed in loose-fitting rubber ring when arm is upright. When arm whips over, centrifugal force rolls ball down short length of angle iron, putting spin on pitch.



"Bazooka," another pitching machine, is really a compressed-air gun. Compressor delivers air to tank at left end of gun, ball is dropped in breech, and trigger valve struck. Velocity can be set from a slow pitch to a 400-foot drive. Rubber fingers at end of barrel adjust to give any curve desired. Less accurate than Overhand Joe, it is fine for fielding practice.

give it the old dipsy-doodle by means of mechanical-finger arrangements. Managers, however, have found that it's tough enough getting their players to hit an ordinary pitch early in the spring without worrying about "breaking stuff." They've given hearty endorsement to Overhand Joe, whose dozen-per-minute performance gives ball players all the batting practice they can handle.

This year, in addition to use in the Dodgers' camp, Overhand Joe will make an appearance in the camps of the St. Louis Cards, the New York Yankees, the St. Louis Browns, and the Pittsburgh Pirates.

Batting tee is a comparatively simple gadget that lets hitter concentrate on improving his form. It consists of auto-radiator hose, adjustable in height and mounted on a weighted base.

Iron Mike, invented and manufactured by a St. Louis banking official, operates somewhat on the principal of a giant sling shot. A claw arrangement holds the ball and a short, heavy rubber band speeds it on its way. The rubber bands are good for between two and three thousand pitches. After that, a replacement, costing $2.50, must be made.

The Dodgers, who have pioneered in mechanical aids, gradually have dotted their training-camp landscape with various gadgets—all calculated not only to save wear and tear but develop better ballplayers. They have, for example, rigged up a gravity-return system of pipes enabling fly balls to be brought first to a central collection point, and then delivered by pipeline back to the pitching machines.

The Dodgers also use stationary batting tees and strike zones outlined by strings drawn taut between uprights. (The former can be constructed for small change from a portion of broom handle and a piece of automobile-radiator hose, mounted upright on a pedestal.)

Naturally, all these devices are butts for good-natured kidding in camp. "I guess," cracked one observer to a Dodger coach, "you'll be getting a few more machines next year and a few more the year after. Do you think you'll eventually wind up by taking the machines South and leaving the players home?" END

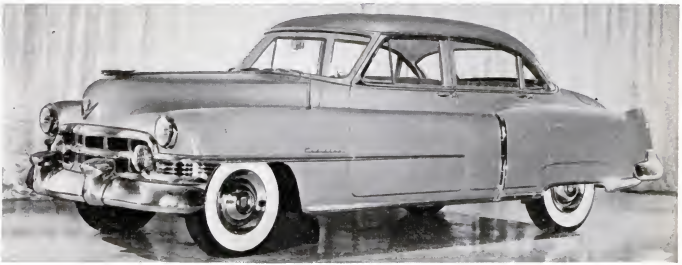
Rectangular TV Tube Cuts Cost

After years of trying to squeeze a rectangular television picture into a round tube, TV manufacturers have come up with the obvious solution—a rectangular tube.

The new tubes, such as the Hytron shown at right above, are much smaller, making possible more compact, cheaper sets. Typical of the large-screen receivers now being marketed by several makers is the Motorola combination console above, which shows a 16-inch picture and sells for about $400. A 16-inch table model is less than $300.

New Austin Is Faster

A new gear ratio to provide a cruising speed of up to 70 miles an hour is announced for the 1950 four-passenger British Austin car (right), being marketed in the U. S. The new ratio is 5.14-to-1. The old ratio was 5.43-to-1. Motorists can get up to 35 miles on a gallon of gasoline.



1950 Caddy Gets Lower Look

The 1950 Cadillacs are lower—as much as four inches in some models. The Series-62 sedan above is five inches longer over-all. This enables the rear seat to be well forward of the wheel housings, providing extra hip room. Wheel bases, however, are three to four inches shorter, except in limousines. Engines warm up faster because exhaust gas is ducted past the carburetor's idle jet. A valve cuts off the extra heat when the engine warms up. Press-fitting piston pins boost bearing area, eliminate bushings.

Here are two quarter-pound sticks of the $50-a-pound uranium metal now on sale. Though it's radioactive, its rays are so mild that you can hold it in your hand without slightest danger.

Uranium For Sale

A-metal goes on market, and other odd metals find new uses, as they step out of chemistry books into everyday living.

By Alden P. Armagnac

WANT to buy some uranium? You can, now, for the A-metal's on the market. Just explain to the New York licensing division of the U. S. Atomic Energy Commission what you want it for, satisfy them that you're a reputable researcher, and you'll get a license entitling you to send in an order.

To meet legitimate needs, the AEC has authorized the sale of 200 pounds of uranium through normal commercial chemical channels. That's news, because in recent years every available ounce of the silvery metal has been earmarked as a source of fissionable material for A-bombs and chain-reacting piles.

Uranium metal is definitely in the luxury class, several times as expensive as silver, for it sells at about $50 a pound. But it's still a bargain. The price would have been $1,000 eight years ago—if available at all

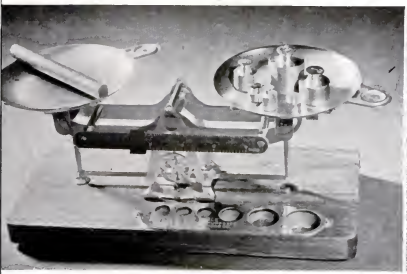
The postman will bring the precious metal in an ordinary screw-cap cardboard mailing tube. It may come from the Mallinkrodt Chemical Works of St. Louis, Mo., which produces uranium from ore mined in the Colorado area, or from other chemical dealers supplied with it by this firm.

One or more black sticks of solid uranium metal, four inches long and a little thicker than a lead pencil, will be in the package. (Although uranium resembles steel at first, it soon turns bronze, and then black, as exposure to air coats it with oxide.) Since uranium is one of the heaviest of metals, 18.7 times as dense as water, even those little rods weigh a quarter of a pound apiece.

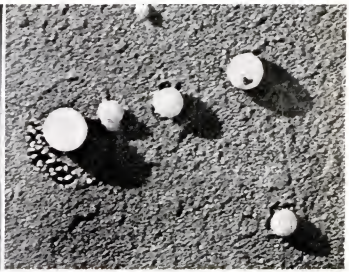
Uranium is radioactive, emitting alpha and beta rays. So the sticks come wrapped in ray-stopping lead foil to avoid any chance of fogging photographic film in the same mail. The rays from an unwrapped stick will make a shadowgraph of a key laid on film in a darkroom, and will swing a Geiger counter's needle across its dial. But they are so mild and harmless that you can hold uranium in your hand with perfect safety.

Needle of ray-detecting Geiger counter swings across dial when probe connected to counter is held beside uranium metal. Meter is set for low sensitivity, or needle would go off dial.

Rays from uranium rod, laid over key on photo film in darkroom, took this picture of key. Rod itself made the glow extending across picture. This is a print from developed negative.



Heaviness of uranium metal is shown by weights needed to balance small rod of it. Total on scale pan and slide is a shade over four ounces. Rods average a quarter-pound apiece.



Form-revealing shadows in this electron-microscope picture, believed to show actual molecules of polystyrene latex, were made with gold. Uranium metal will help get even better views.

And in contrast with some radioactive materials, you needn't hurry to use uranium while it lasts—for its half life is a generous four and a half billion years!

The uranium you get won't be quite pure enough to use in an atomic pile, nor will it be artificially enriched in U-235 as an atom bomb requires. But that won't matter to you, for Uncle Sam would frown on your running a private pile or making a bomb anyway. By ordinary standards it will be highly refined and suitable for whatever else you want to do with it.

Several of the purchasers whose orders have already been filled, usually for a pound, or four sticks, of uranium metal, will use it to "shadow-cast" specimens for study with electron microscopes. Germs and equally tiny objects stand out clearly in relief under the microscope, with their true form emphasized by apparent shadows, after a thin film of a heavy metal is deposited obliquely on them in a vacuum. Of the metals tried to date—which include chromium, manganese, palladium, and gold—uranium works best.

Ostensibly for making steel alloys, Russia obtained 500 pounds of uranium-containing oxide from Canada in 1943, it was recently revealed. Whether that's what they did with it, the record doesn't show—but it's another possible application of uranium. According to the U. S. Bureau of Mines "Minerals Yearbook" for 1941, "Uranium imparts desirable properties to tool steels. The metal is introduced as ferro-uranium, or as a master alloy containing 66 percent uranium and 33 percent nickel." More recently, properties of uranium alloys with aluminum, tungsten, tantalum, manganese, and copper have been investigated and made the subject

Gallium metal is strange new by-product of extracting aluminum from bauxite ore. Above, a cube of gallium is melted by body heat when it's held in the hand. It liquefies at only 86° F.

Crucible of liquid gallium, resting on balls of white-hot alumina in furnace above, can be heated to 3,600° F. before metal boils. It replaces mercury in high-range thermometers.

of several AEC reports. The uranium now for sale will permit wider studies of this kind.

Physicists should find uranium metal a useful tool, the AEC suggests, to study the strange behavior of substances at extremely low temperatures, where their electrical resistance mysteriously vanishes.

Formerly about the only known use for uranium and its chemical compounds was as a coloring agent for amber signal glass, yellowish-green "uranium glass," and red and orange tile. Said the 1940 pre-atomic-era edition of the yearbook already quoted: "Increased output of radium has raised again the question of disposing of the jointly recoverable uranium." It's come a long way, uranium has, since people wondered what to do with it!

So have quite a few other rare or unfamiliar metals that until recently were only names in chemistry books. One of these days, if you haven't already, you'll be making the acquaintance of such up-and-coming metals as beryllium, gallium, germanium, lithium, molybdenum, rhodium, sodium, and titanium.

Odd Metal Melts in Hand

Pick up a piece of silvery gallium metal, and it melts in your hand! Like mercury, it liquefies at a temperature below body heat, 86° F. to be exact. Since it boils at a temperature far higher than mercury does, the queer metal has been used as a liquid in thermometers that register up to more than 1,800° F. New uses are expected to result from its recovery, just begun by the Aluminum Company of America, as a by-product from the aluminum-bearing ore bauxite. One is in an extremely strong new dental alloy for fillings that won't fall out.

Did you ever see any molybdenum, not mixed in alloys like chrome-moly steel, but the pure stuff itself? Not long ago, Westinghouse learned how to produce the first 250-pound ingots. In contrast to gallium, molybdenum melts at the toplofty temperature of 4,750° F., nearly 2,000° above the melting point of iron. Hence engineers foresee molybdenum nozzles for rockets and blades for gas turbines—and, perhaps, firewalls to protect jet fliers from fire.

Mirrors now get a coating of rhodium metal, better for "silvering" than silver. Called "poor man's platinum" because it's a less expensive member of the platinum group of metals, rhodium also gives a handsome plated finish to cigarette lighters and safety razors of well-known makes.

Titanium's the talk of the town when engineers get together. Although it's heavier than lightweight magnesium alloys, it's so much stronger that aircraft parts of half the weight can be made from it. Silver-white and ductile, it's even more corrosion-resistant than stainless steel, report interested experimenters of the Remington Arms Company. The ore is the fourth most plentiful of any structural metal's, but how to get the metal out has been the $64 question, until National Bureau of Standards metallurgists recently hit the jackpot with a new method.

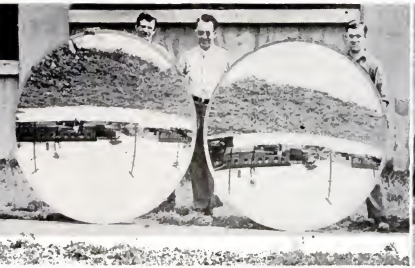
Unusual metals mean unusual processes. One modern engineering stunt is to use liquid metal, like the water in your car's cooling system, for cooling and heat transfer. The new atomic pile of the Knolls Atomic Power Laboratory near Schenectady,

Crystal of gallium, in exhibit, is embedded in plastic cylinder so handling won't melt it. Reflection (left) is in glass coated with liquid gallium, which adheres as mirrorlike surface.

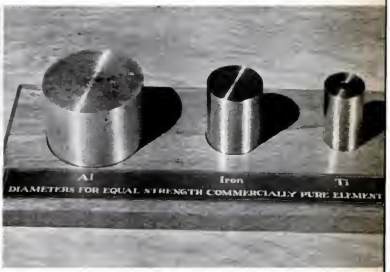
Expanding as it freezes, gallium cracks bottle at left and exudes from its neck, just like frozen milk in bottle at right. Rubber syringe bulbs make unbreakable containers for shipping.

Non-magnetic tools of beryllium copper like these are used by workers in Oak Ridge atomic plant, where powerful electromagnets would jerk steel ones out of men's hands.

Pure molybdenum metal melts at high temperature of 4,750° F., and use is foreseen in rockets and gas turbines. Silvery metal acquires high luster from buffing, as these samples show.



Rhodium metal now makes mirrors, above, for searchlight reflectors and optical instruments. Front-surface coating of rhodium, eliminating double reflection, doesn't tarnish as silver does.



Titanium is light and strong new structural metal. Titanium sample at right shows amount required to give same strength as aluminum, left, and iron, center. Du Pont produces it.

Cooling with sodium metal protects valves of aircraft engines from corrosion and distortion by heat. Sodium snipped from rod (left) is sealed in hollow valve. Engine heat melts it. When valve is open (center), sodium at bottom absorbs heat. Closing of valve throws sodium upward into stem (right) and heat escapes through metal to cooling system.

N. Y., will employ a "liquid-metal coolant." The particular metal or metals haven't been revealed. But at Oak Ridge National Laboratory, they've tried out an experimental cooling system using an alloy of two rarely seen metals, sodium and potassium, in nearly equal parts. The odd alloy is liquid at ordinary room temperature, melting at about 59° F. Sodium-cooled valves, using sodium metal alone (melting point, 175½° F.), have made possible high-power airplane engines.

Because ordinary hammers and wrenches would be jerked right out of workers' hands by the tremendously powerful electromagnets of the U-235 separation plant at Oak Ridge, Tenn., the men there use tools of beryllium copper. This non-magnetic, reddish-gold alloy of beryllium metal and copper is also non-sparking, so that the tools can be used safely in places like powder plants where sparks could cause an explosion. Production of pure beryllium metal, formerly a rare laboratory curiosity, has meanwhile been spurred on by its desirable properties as a structural material for atomic piles—although its dust is so toxic that it has to be machined within a ventilated glass box to protect the operator outside.

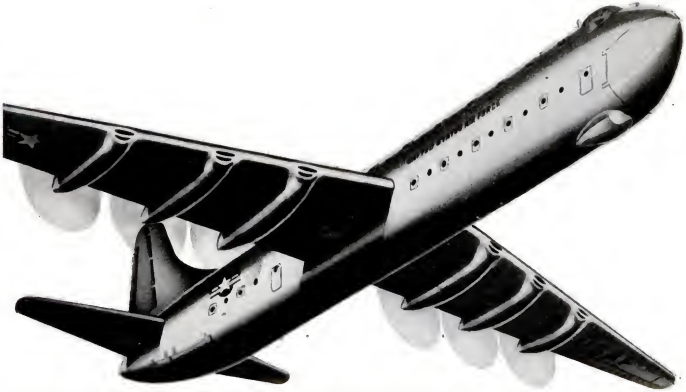
"No use at all has been found for germanium," said a book on metals 10 years ago. One of the latest and most promising metals to make headlines, germanium is now the key material that rectifies electric current in radio and radar circuits and in "transistors," which may replace vacuum tubes.

Lenses of germanium metal and of silicon metal, opaque to visible light but transmitting infrared or "black" light, have just been produced by a Purdue University group headed by Dr. Karl Lark-Horowitz. They promise spectacular advances in infrared equipment and possibly improved designs for military devices like the World War II "sniperscope," used to see and aim guns in the dark with the aid of these rays. Incidentally, silicon is one of the commonest (in sand) but most rarely seen elements.

Lithium Saves Lives

About half as heavy as water, lithium is the lightest metal known. Lithium hydride, a grayish-blue to white crystalline compound of lithium and hydrogen, is correspondingly light. Carried in airplanes' emergency equipment, the chemical helped save many lives in the last war. By reacting with water, it liberated hydrogen to fill balloons that carried radio antennas aloft from life rafts of fliers forced down at sea. The silver-white metal itself, hardly known outside the laboratory 10 years ago, now hardens lead and aluminum alloys. Its vapor, produced by heating a cartridge of lithium, protects sheet metal and machine parts undergoing heat treatment in furnaces.

History will almost certainly repeat itself with other odd metals still awaiting use. Unmindful of immediate reward, the chemists and physicists carefully explore and catalog the properties of each one. Years or decades may go by. Then, one day, along comes an application requiring just such-and-such a melting temperature, density, or manner of chemical behavior—and another element steps out of the chemistry books into everyday living. END



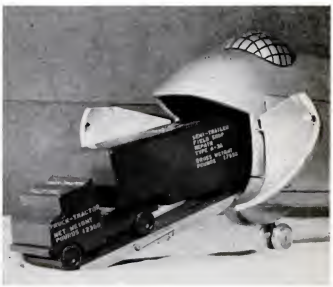
Proposed cargo version of B-36 bomber could carry a medium tank and 30 equipped troops.

U.S. to Europe with 50 Tons

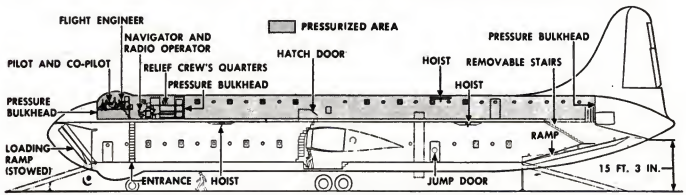
THIS cargo version of the Consolidated-Vultee B-36 six-engine bomber, submitted as a design proposal to the U. S. Air Force, would carry a record load of 400 fully equipped troops or 50 tons of materiel across the Atlantic at over 300 m.p.h.

The double-decked C-99, as the plane has been labeled, is an outgrowth of the XC-99 experimental transport. It could take off from U. S. bases with a full load and fly nonstop to any point in England or western Europe. One version of it could tote 343 litter patients and 33 attendants. Its 21,715 cubic feet of usable space is an increase of more than half again as much as the XC-99 contains. Forty-four of the airplanes could transport an entire air-borne division.

The entire upper deck, including crew's compartment, would be pressurized. END



Clamshell doors at front and rear of fuselage would provide entrances measuring almost 12 by 13 feet, sufficient for trucks and trailers. Upper deck alone could accommodate 183 troops.



Profile drawing of proposed transport shows pressurized area, hoists for lifting, stowing cargo.

In proposed $1,000 Nash, drop-center hood is below fender line to give maximum vision.

Nash Shows Its "Maybe" $1,000 Car

WHAT a $1,000 automobile might look like—if the public ever gets a chance to buy it—is being demonstrated by Nash Motors with a hand-built, two-passenger convertible now on a tour of key U. S. cities.

Exhibiting it strictly as a "maybe" vehicle, Nash is asking people who come to look: "Do you like this car? Would you buy it if we built it?" Whether the company will turn it out for sale at any time in the future remains a question.

Only one of the cars is in existence. It has styling features designed to take advantage of cost-shaving short cuts in manufacture.

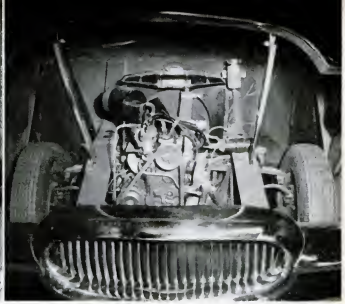
Using relatively inexpensive, low-horsepower foreign engines and transmissions avoids a lot of initial tooling-up expense. European manufacturers already are making engines for their own market and could make them for Nash. The display model has a Nash-built body on an Italian Fiat chassis, with an 18-hp. engine. The production model would have a Nash Airflyte chassis in which the frame is an integral part of the body. An optional power plant might be a British Standard or a larger Fiat engine, both developing 36 hp.

Body costs would be sliced by peeling away excess chrome and gingerbread ornamentation. Dual-purpose dies would be used where possible. On the display model, front and rear bumpers are identical castings. The left front and right rear fenders can be stamped from the same set of dies. The same is true of the right front and left rear fenders. The hood and the turtleback are identical stampings, as are the two doors.

The trunk lid is eliminated. This means no hinges or lock mechanism, cutting down assembly time. The luggage compartment behind the seat can be reached only from inside the car. Windows are raised by a strap. You push them down.

The big question is the market for such a car. Who would buy it? Nash has stated that if the survey indicates a sale of 200 cars a day with an eventual demand for 300 to 400 a day, the company *might* build it.

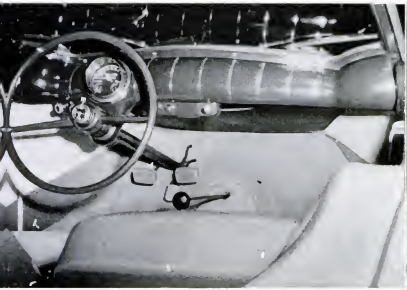
Except for break at door, fender line is carried through from front to back to give appearance of length. Spare tire is stowed ahead of rear bumper below lidless luggage compartment.



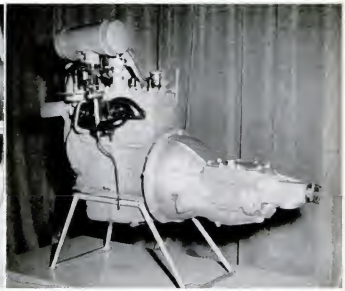
Entire front end—hood, fenders, headlights—lifts as unit to give easy access to engine. Shown is 18-hp. Italian-built Fiat engine. Note that the radiator and fan are behind motor.

Luggage compartment behind seat is roomy considering car's smallness. Wheelbase on production model would be 84 inches, some 30 inches shorter than on today's "low-price" cars.

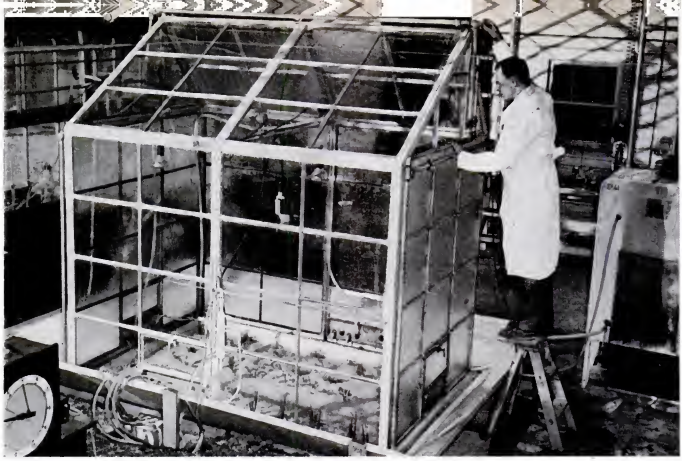
Plastic strap to raise window is snap-anchored to door at desired height. Nash proposes 145-inch over-all length as against U. S. average of 188. Height is 53 inches and width is 62.



Accelerator between clutch and brake is Fiat design, but could be modified. Weight with 18-hp. engine is 1,350 lb.; with 36 hp., 1,450 lb. Small engine gives 50 miles per gallon.



Possible alternate engine is this 36-hp. British Standard. Production car would have 47-inch tread, and a top speed of about 65 m. p. h. Nash says doubling power would add $50 to cost.

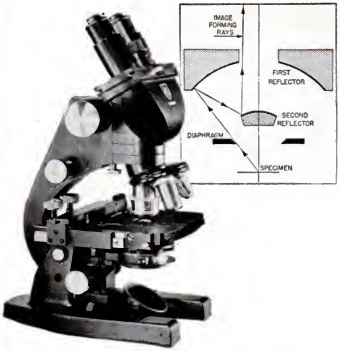


Growing Radioactive Food

BUCKWHEAT, sugar beets, tobacco, foxglove, and opium poppies grow in an atomic garden at Argonne National Laboratory, Chicago. Breathing radioactive carbon dioxide gas in a sealed chamber, above, they yield ray-emitting foods, vitamins, and other drugs. Substances that chemists cannot duplicate synthetically are thus tagged with radioactive carbon for tracer experiments on what happens to them in the body.

Pedals Drive Balloon Props

FROM $400 worth of bicycle parts, Charles K. Paul of Woodbridge, N. J., built the "pedalcopter" seen in flight above. Helium in its gas bag gives it almost enough lift to rise. He supplies the rest by pedaling a sprocket that turns a horizontal propeller. A control stick varies blade pitch to maneuver forward, backward, or sidewise.



Microscopes Use Mirrors

MIRRORS replace objective lenses, bringing light of all wavelengths to one focus, in new microscopes. Ultraviolet photos follow visual observation without change of setting. A turret may mount several mirror objectives of different magnification. An American Optical Co. mirror microscope and its optical system are shown above.

This Army cargo carrier packs a 30,000-lb. payload. It has a V-12, air-cooled, 810-hp. engine.

New Army Tractors Steer Like Planes

Cross-drive transmission and "wobble-stick" control make these tracked jobs easier to steer than a truck.

By John F. Loosbrock

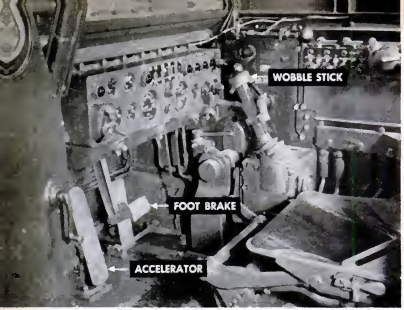
PS photos by W. W. Morris

HERE'S a combat tractor that steers like an airplane. A single "wobble stick," combining the functions of gear-shifting and steering, controls all movement—forward, backward, and turning. To shift from lower speeds to higher, just pull back on the stick. All the way back is reverse. You can shift directly from high to reverse without stopping or even going into neutral. To turn left, shove the stick to the left; for a right turn, shove the stick to the right.

The secret is a new cross-drive transmission that Army Ordnance is building into its latest tanks and cargo carriers, like the 15-ton T-44 pictured above.

This uses a "split-torque" power train, part mechanical and part hydraulic torque converter. This divides the power delivered to the two tracks in the proper proportions for accurate steering. For a left turn, the right driving sprocket gets the lion's share of the power and vice versa. Sharpness of a turn depends partly on the speed of the vehicle. At zero speed, a tank can be pivoted literally on a dime, with one sprocket driving forward and the other in reverse.

The new tracked jobs, like the Army's new trucks, are getting a workout at Ordnance's Aberdeen Proving Ground, Md. (PS, Nov. '49, p. 121, and Jan. '50, p. 168). To check on their performance, the Aberdeen experts use the world's largest mobile dynamometer (PS, Aug. '49, p. 144). This 60-ton monster, shown in detail on the next page, is pulled by the test vehicle and accurately measures its performance.



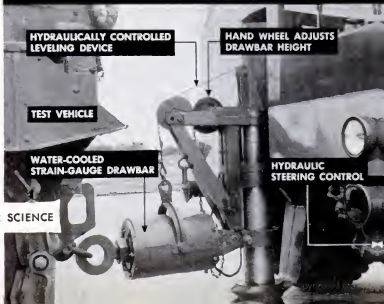
Cab interior of cargo tractor shows simplified "wobble-stick" steering and gear-shifting arrangement. Steering and shifting are done with one control stick. There's no clutch pedal.

Bogies use torsion-bar suspension, similar in theory, though not in design, to that on new Army trucks. On tracked vehicles, bar that twists to take up shocks runs across vehicle.

Raised hood shows two huge air cleaners that feed the carburetor. Front plate below cleaners can be unbolted and entire engine and transmission slid out for repair or replacement.

Dynamometer is 44½ feet long. Power

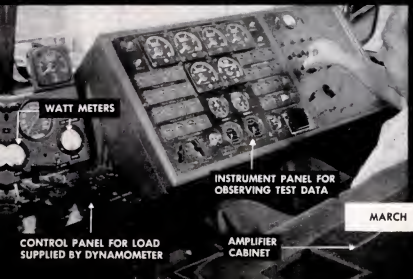
In field tests vehicle is coupled to dynamometer by strain-gauge drawbar. This can carry tension or compression loads of 400,000 lb.

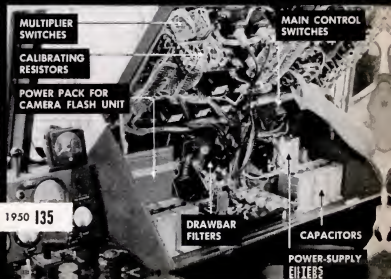


train has two 500-hp. engines driving generators that run four motors that drive wheels.

Complicated instrument panel tells operator just what goes on during test run. A permanent record is made with a 35-mm. movie camera.

Raised panel gives idea of maze of electronic tubes and wiring needed to transcribe data. Instruments are indicators or electronic counters.



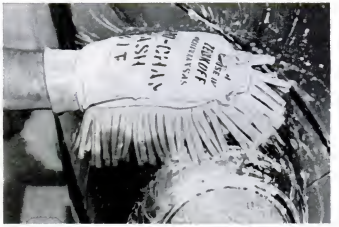


Flash Lasts 2/1,000,000 Sec.

After smashing through a glass jar, a .22-caliber bullet broke the electrical conductor at left, setting off a new high-speed photographic light. Its flash illuminated the action for two-millionths of a second while an ordinary camera took the picture. The new light, developed by General Electric, makes possible the photographing of objects moving at speeds far beyond the capabilities of the fastest camera shutters. The photographs are used for research into the behavior of high-speed missiles and supersonic aircraft, revealing air-flow patterns around wind-tunnel models.

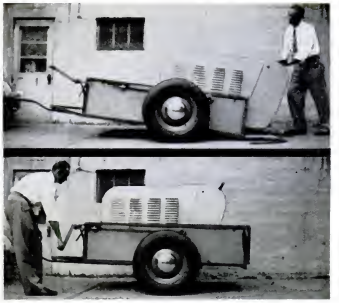
Mitt Makes Car Shine

The spaghetti-like tentacles of this mitten for car washing are made of cotton yarn covered with Du Pont cellulose sponge. The manufacturer of the new Spo-Cham® wash mitt, the Zelinkoff Co., of Wichita, Kansas, claims that it wears three to five times longer than ordinary cotton mop yarn, is two to three times more water-absorbent, and leaves no lint. When the car is done, the mitt can be used for washing windows or scrubbing floors.



Monocular Gives an Eyeful

The new single-tube, seven-power monocular being used by the girl above gives the same field of view as the 7 x 50 binocular used extensively by the Navy during the war. Light in weight, it's small enough to fit in a suit-coat pocket. Designed by Bausch & Lomb, the instrument has a 35-mm. objective and focusing eyepiece. Optical parts are coated for maximum light transmission. It sells for $77.50 with carrying case.



Trailer Kneels for Loading

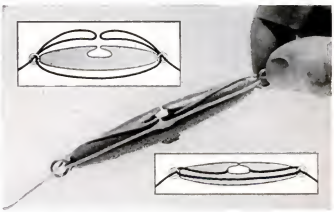
This Hercu-Lift® trailer can be lowered to street or curb level for easier loading, as shown in the upper photo just above. It is then raised to traveling position by a crank, as demonstrated in the lower picture. The trailer, measuring 24 by 48 by 72 inches, is made of waterproof plywood on a welded angle-iron frame, and sells for $225. It-Ro Industries, of Portland, Ore., makes it.

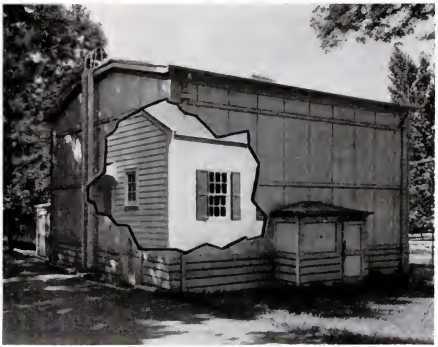
Robot Processes Color Film

THE Air Force sergeant above is starting a rack of ten 8-by-10 color films on a 90-minute automatic journey through 12 stainless-steel tanks filled with processing solutions. All he has to do is set the timers above each tank and start the machine. The rack of films will be dunked into the first tank, then lifted out automatically at exactly the right moment and moved along to the next tank. Because it insures absolute uniformity in processing, the new device is being used by the Air Materiel Command to measure accurately the capabilities of various types of color film available.

Sinker Ends Tangles

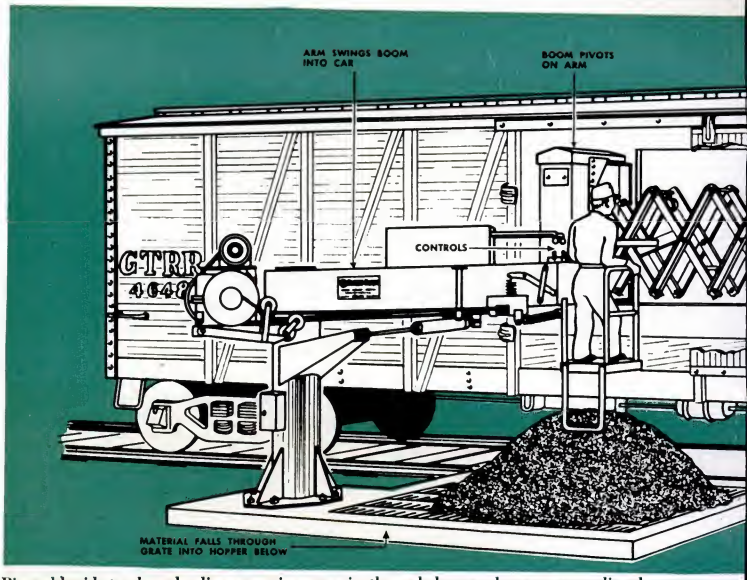
TWISTED fishing lines are reported a thing of the past with the Eze-Way® lead sinker shown at right. When the cutaway section is bent shut, the sinker is thrown off center. This restricts spinning action to the bait end of the line, beyond the sinker. Line is looped through eyelets, the loops are then caught over cutaway points, and the gap pressed shut. The Paul Bunyan Bait Co., of Minneapolis, offers nine sizes from ⅛ oz. to 2½ oz.





House Goes Under Cover

TO TEST various types of heating systems, the National Bureau of Standards built a typical low-cost bungalow. Then they covered it completely with an outer insulating shell, shown left with bungalow visible through cutaway section, so that temperature conditions of any place in the United States can be duplicated. All rooms of the house, except the bath, have movable ceilings that can be adjusted two feet by overhead screw jacks.



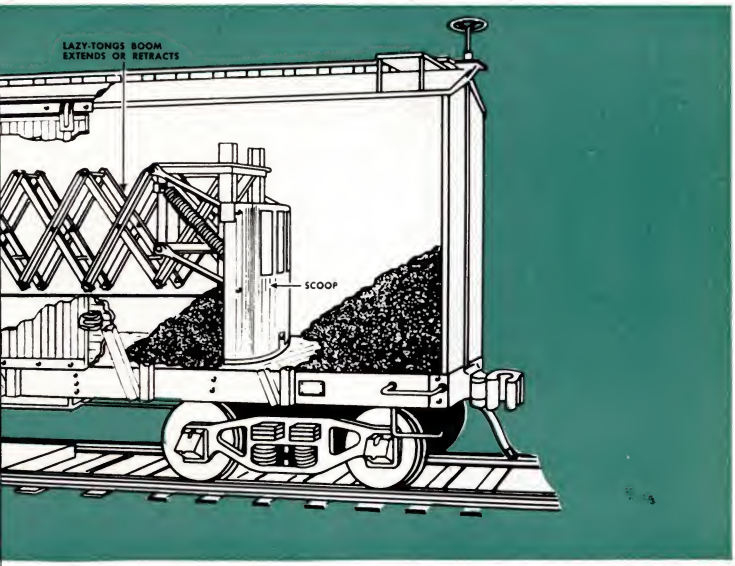
Pivoted beside track, unloading scoop is swung in through boxcar doors so accordion boom

Long Arm Unloads Boxcars

THIS giant mechanical arm reaches right into a boxcar and scoops out its cargo. Designed to speed the unloading of grain, sand, dry chemicals, and similar cargoes, it can empty an average-size boxcar—even sweep the floor clean—in 30 minutes.

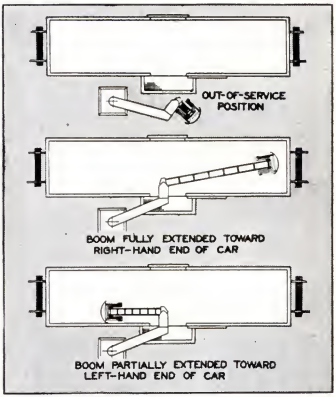
The lazy-tongs arm needs only to be started in the right direction. Then it "feels" its own way, pushing ahead until it meets a wall or part of the cargo and builds up pressure. When this pressure reaches 200 pounds, the scoop automatically lowers, digs into the pile, and then retracts. At the door, it pushes out the load, lifts up, and goes back for another bite.

Single operator, riding arm on platform, need only aim scoop toward desired part of car. After this, its extend-dig-retract cycle is automatic. It is made by Stephens-Adamson Co., Los Angeles.



reaches all parts of car. Cargo, pulled out door, falls down through grate into collecting pit.

Brush on scoop sweeps floor almost clean, leaving only few grains to be removed by hand, as rollers guide arm along walls. Attaching brush to complete job is only manual operation.



Top drawing above shows how unloading arm can be retracted and swung aside when not in use. Lower views show how elbow joint near door permits arm to be swung toward either end.

Restyled Frazer line of cars is available with standard transmission, overdrive, or Hydra-Matic.

Kaiser-Frazer Adds Crash Pads

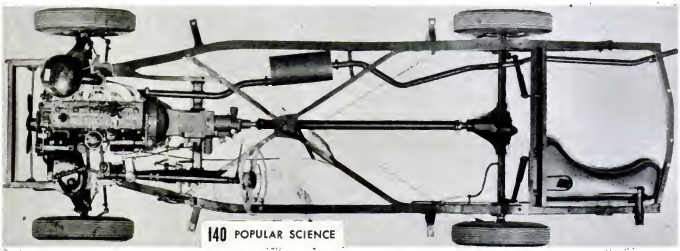
KAISER-FRAZER has announced the first major changes in their automobiles since their introduction after the war. The results of the company's two-and-a-half-month shutdown last fall and winter are evident in new styling, lower profiles, greater vision, and—in the case of the Kaisers—more power.

Both lines have what the company calls the industry's first full-padded, crash-absorbing instrument panel. Crash pads have been tried before by other car manufacturers, but one company abandoned them in mid-season. That particular automobile maker apparently shied away from the implication that people might crack their noggins in sudden stops or collisions.

The snappy styling includes mounting the side glass nearly flush with the exterior body panels both for looks and to reduce wind noise. A "radiator" ornament breaking the curve of the hood to the grille at the front of the car is now standard equipment.

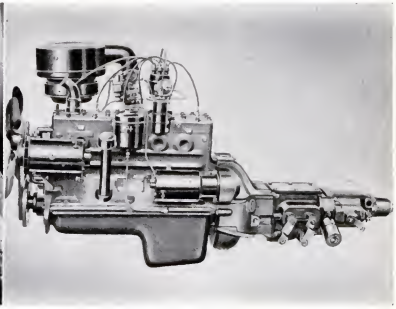
The Kaiser is offered in six body types, including 2- and 4-door Traveler utility sedans (PS, Apr. '49, p. 106). Among the five body styles in the Frazer is a hard-top model that resembles a convertible.

New Kaiser chassis is 60 lb. lighter than predecessor and is designed to place greatest body load on strongest members. Frame is double-channeled around motor and in rear-wheel area.



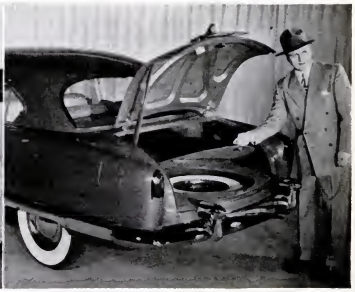
1950 Kaiser is 60 inches high, with center of gravity cradled below tire line. Company will announce another type of car, built for Ford-Plymouth-Chevrolet price range, in late spring.

Kaiser crash pad extends full width of instrument panel. Speedometer is hooded to prevent glare on windshield at night. Wheelbase is reduced 5 in.; over-all length is boosted 1¾ in.



Refinements increase horsepower of 6-cylinder L-head engine from 100 to 115 without any change in bore, stroke, or 7.3-to-1 compression. Redesigned crankshaft is 100% counterbalanced.

Slim windshield pillar contributes to what company claims is larger passenger-car glass area than that of any other U. S. automobile. Safety-glass windshield has area of 3,541 sq. in.



Recessing spare wheel under luggage-compartment floor is a new wrinkle in K-F cars. Both front and rear seats are wider. Ignition key operates all locks, including that on trunk.

Using new Hollywood semaphore system, a director of photography signals that a scene just filmed is okay. Photos on these pages were taken for POPULAR SCIENCE at the Goldwyn Studios.

New Wigwag Signals Direct Movie Scenes

HOLLYWOOD has borrowed a trick from the landing officer on aircraft carriers. The result is a new system of arm signals for giving orders during the shooting of scenes on big sets and outdoors. They take the place of haphazard "high signs" and shouted orders that are often drowned out by the wind or garbled by echoes.

The code, cooked up by assistant director Bill McGarry and cameraman Harry Webb, has been submitted to the Academy of Motion Picture Arts and Sciences for adoption.

5 **"Once more."** The trouble has been corrected and the director takes over again by holding one arm horizontal and the other bent upward at the elbow. Then the cameras roll.

6 **"Camera right."** The director conveys this order to the camera crew by holding his right arm out horizontally from the body and his left arm bent to place hand over the head.

1 **"Upstage."** This signal to the cast indicates that some actors have come in too close and must move back. Hand on hip and arm down at same angle orders cast to move in closer.

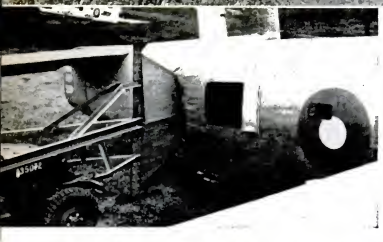
2 **"Roll camera."** When scene is ready, director gives this order by holding arms slanted in a straight line. Advantage of signals is that they can be understood from front or rear.

3 **"Cameras rolling,"** signals back the cameraman by holding arms straight out as above. Then director, with arms held same way, but rotating one or both, orders "Action."

4 **"No good,"** signals the soundman, holding both arms down at a 45-degree angle. This signal stops cameras and action. Some noise, such as a passing plane, may have been heard.

7 **"Camera left."** To give this order, the director simply reverses the previous arm positions. Another signal, arms crossed overhead (not shown in these photos), indicates a rehearsal.

8 **"Okay, cut!"** By holding one arm out horizontal and the other folded across his chest, the director indicates: Action, good; sound, satisfactory. Only director ever uses this sign.



"Can Opener" Saves Lives

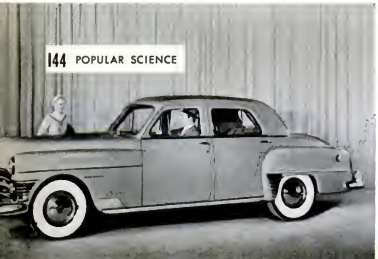
This motorized "can opener" chops apart an airplane fuselage to give air-crash victims a better chance to escape. Made of sheets of razor-edged steel eight feet high, it is mounted on an armored car. The Melbourne, Australia, Department of Works and Housing designed and built the life-saving device. In a recent demonstration it was tested on an old RAAF Liberator, cutting the tail right off (left and above).

Chrysler Gets Bigger Brakes

Fanciest of the Chrysler Corp. line, the 1950 cars bearing the company name have been souped up in styling and engineering. Wider brakes require less pedal pressure, and a rear window with 27-percent greater area improves vision. An automatic switch keeps the stop light off on the side a turn signal is flashing. You can choose from 19 body styles—ranging from coupes to hardtop convertibles and eight-passenger sedans.

Plastic Ball Tells Weather

People in Minneapolis learn the weather forecasts now by watching this ball of light atop a local bank (below). Neon tubing inside the plastic sphere glows red when the forecast is warmer, white for colder, green for no change. The lights flicker for rain or snow. The big letters "NW" don't indicate wind direction—they stand for Northwestern National Bank. The weather ball is set manually to agree with official forecasts.



Liquid plastics are mixed in test tube to demonstrate new material's expansion qualities. Mixture heats up to 300° F. and begins to foam.

Three minutes and 15 seconds later compound has foamed to this size. As many as 1,100 combinations of varying densities are possible.

Plastic Foam Fills Plane Parts

CHEMISTS of the Lockheed Aircraft Corp. combine many chemicals and organic plastics to make a feather-light but tough new material called Lockfoam®. When mixed in liquid form, the plastics heat and swell to as much as 25 times their original volume. The foamy mass then hardens into a porous material that weighs only four pounds per cubic foot, which is three times lighter than cork. Lockheed uses Lockfoam to fill ailerons, trim tabs, and elevators on aircraft, replacing many internal parts.

Lockfoam can be cast in any shape. Here it fills an aircraft aileron tab, giving greater rigidity with fewer internal metal parts.

Machine Vacuums Streets

THIS mechanical street sweeper works like a vacuum cleaner. An agitator loosens debris, while an 1,800-r.p.m. fan blows leaves, stones, and even bottles into a wire-mesh hopper. The hopper dumps hydraulically into a truck. Tractor-mounted, the sweeper can be operated by one man. Harry Clemens, La Porte, Ind., is the inventor.

Flying Banana Gets New Skin

THE Navy's latest transport helicopter, the Piasecki HRP-2, has an aluminum fuselage, instead of fabric covering, to cut down drag and vibration. Its new cockpit has side-by-side pilot seating, dual controls, central instrument location, and improved vision. Designed for rescue work, it has eight seats plus space for nine litters.

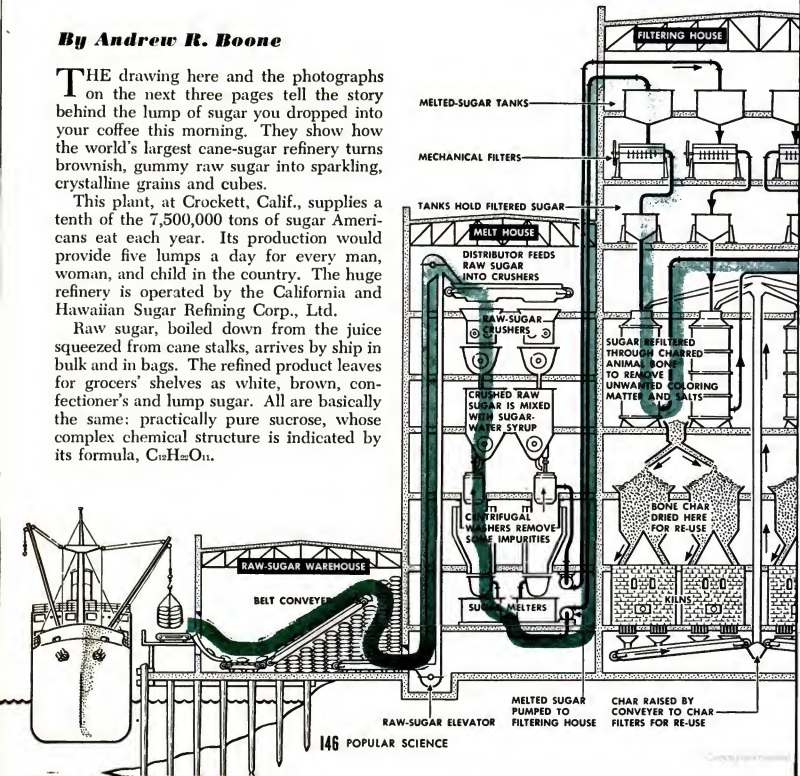
750 Million Lumps of Sugar Every Day

By Andrew R. Boone

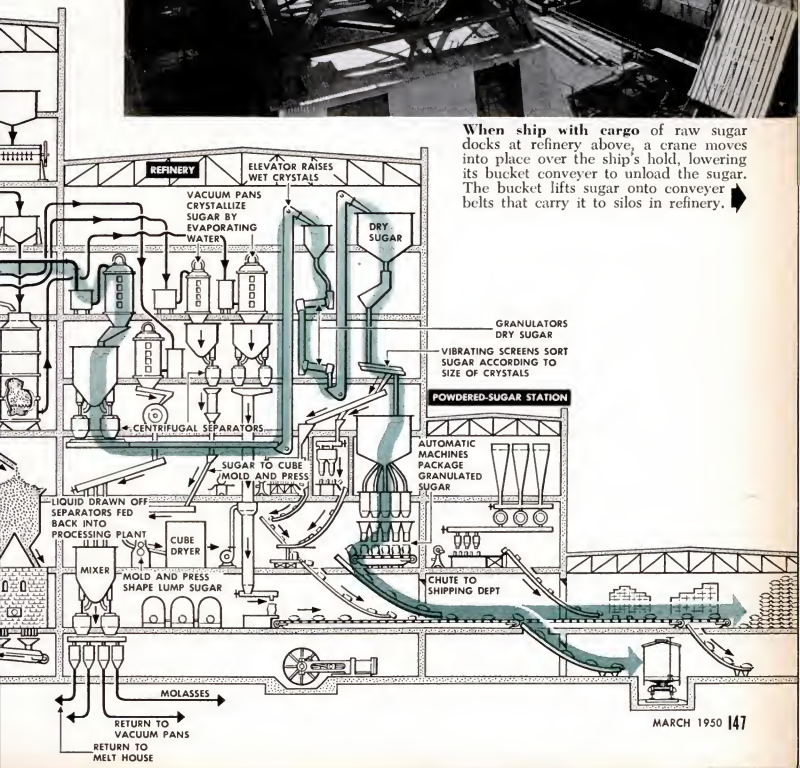
THE drawing here and the photographs on the next three pages tell the story behind the lump of sugar you dropped into your coffee this morning. They show how the world's largest cane-sugar refinery turns brownish, gummy raw sugar into sparkling, crystalline grains and cubes.

This plant, at Crockett, Calif., supplies a tenth of the 7,500,000 tons of sugar Americans eat each year. Its production would provide five lumps a day for every man, woman, and child in the country. The huge refinery is operated by the California and Hawaiian Sugar Refining Corp., Ltd.

Raw sugar, boiled down from the juice squeezed from cane stalks, arrives by ship in bulk and in bags. The refined product leaves for grocers' shelves as white, brown, confectioner's and lump sugar. All are basically the same: practically pure sucrose, whose complex chemical structure is indicated by its formula, $C_{12}H_{22}O_{11}$.



When ship with cargo of raw sugar docks at refinery above, a crane moves into place over the ship's hold, lowering its bucket conveyer to unload the sugar. The bucket lifts sugar onto conveyer belts that carry it to silos in refinery.



1 This is one of nine steel silos, each having a capacity of 10,000 tons, for storing raw sugar. Light brown and coarse in appearance, the sugar is unloaded from the silo by the clamshell bucket above. Positioned by a traveling overhead crane, the bucket drops the sugar down the large tube in the center of the silo. From here sugar travels to refining machinery.

4 Boiling the syrup under vacuum to evaporate the water is the next step. The huge steam-heated vacuum pan below, 24 feet high and 14 feet across, is used for this operation.

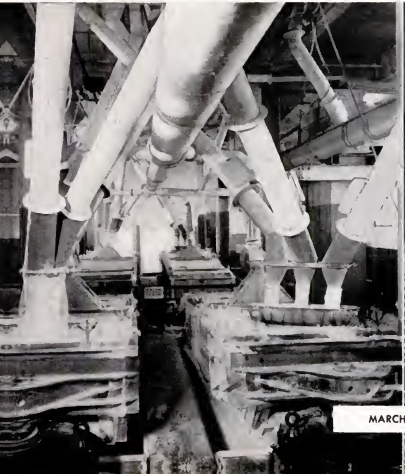
5 Operator pours sugar crystals into the vacuum pan to induce crystallization of the syrup. Forty tons of crystal-syrup mixture, called massecuite, results from one cooking.

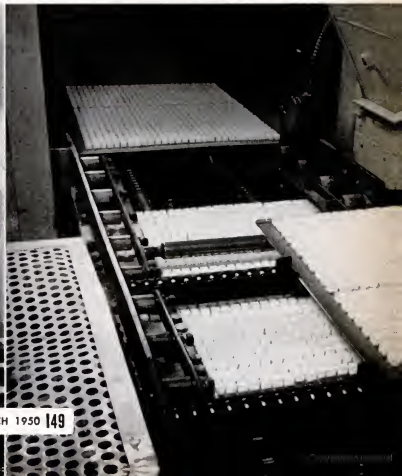
2 **After molasses coating** on raw sugar is softened with a heavy sugar-and-water syrup, mixture is washed and whirled in centrifugal machine above to remove some impurities.

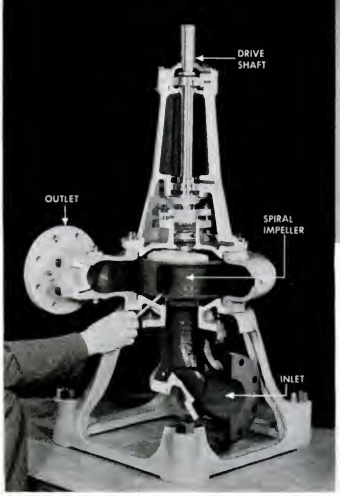
3 **Melted sugar mixture,** now a clear amber syrup, strains through fine-mesh screening above in final filtering step. Before this, mixture passes through about 100 other filters.

6 **To obtain granulated sugar,** crystals are separated from syrup, dried in a rotating cylinder, then shot down tubes to machines, below, that sort grains according to size.

7 **Lump sugar is made** by pouring melted sugar into rectangular forms, cutting them in cubes, and molding with a cylinder. Cubes below move into drying oven as final step.







Trash Won't Clog New Pump

Rags and other trash sometimes clog the pumps in sewage-disposal systems, making frequent cleaning necessary. To overcome this obstacle, Fairbanks, Morse & Co., of Chicago, has designed a pump that eliminates the trash-catching impeller blade of conventional centrifugal pumps.

Instead, the new pump has a single, coiled-up tube (above), big enough to let both liquids and solids pass through without catching, that rotates on a central axis. Entering at the center, the fluid spirals outward as the tube spins. This speeds up the fluid and shoots it out through the tube's discharge end at the outside of the spiral. The new pump will handle trash 25 times as large as that passed by a conventional pump with its narrow impeller blades.

Because of its gentle action, the bladeless pump may also be useful in food-processing industries. In a recent test, oranges and apples passed through it without being damaged at all.

Oil Derrick Wears "Overcoat"

The odd-looking structure towering skyward below is a covered oil derrick. Erected at the Naval oil field in Point Barrow, Alaska, the derrick's framework wears an "overcoat" to protect men and equipment from wintry Arctic blasts.

File Cabinets Become Desk

If you place this snug-fitting metal top over a couple of file cabinets, as shown above, you have a desk. Measuring 24½ by 50 inches, the desk top is easily removed for rearranging an office. The Sect-o-desk® cabinets measure 30 by 24 by 15 inches, come with drawers or a door. Made of heavy-gauge steel by Kalmus-Golden, Inc., New York City, the complete unit sells for $49.50. Cabinets may be bought separately.

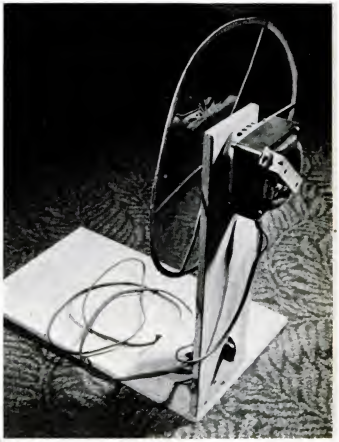
Color TV is no mystery to Forrest Killy—he watches test broadcasts with this homemade rig.

PS Reader Makes Own TV Color

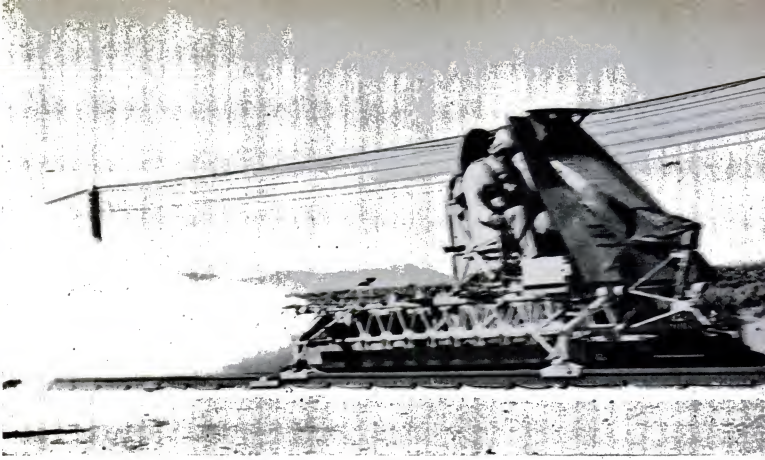
WHILE experts haggled over how difficult it was to put color television into an ordinary set, a POPULAR SCIENCE reader went ahead and did it. Total cost: 30 cents.

Forrest W. Killy, a young electrician of Roselle, N. J., thought it would be fun to peek while the Columbia Broadcasting System broadcast color-television tests. So he picked a phonograph motor, condenser, switch, and rheostat from his junk box and spent the 30 cents for some red, blue, and green cellophane. He cut the cellophane into wedges and pasted them on cardboard and wire to make a color wheel. The phonograph motor, its speed controlled by the rheostat, spins the wheel. The condenser and switch, wired into the horizontal sweep circuit of Killy's standard black-and-white TV receiver, change the picture from the 525-line basis ordinarily used to the 405 lines of Columbia's color system. (This line conversion, simple on the particular model Killy has, would be complicated on others.)

Upon spotting a color telecast (until recently tests were transmitted at irregular "off" hours), Killy slid the color wheel in front of his set, plugged the motor in, and switched the set to the 405-line color scan. The rheostat must be adjusted until the color wheel rotates exactly in time with the color wheel in the studio camera. This is a little tricky with Killy's rig—the colors may change back and forth until the adjustment is just right. Yet Killy's simple converter can show the colors quite accurately. And so far as CBS knows, he has been the only private citizen in the country to see even that much color on his own set. END



Except for a condenser and switch in the horizontal sweep circuit of the set, this is all there is to the converter: a color wheel of cellophane, a phonograph motor, and a rheostat.



Airmen "Crash" On Rocket Sled

WHEN the first man-carrying rocket takes off on its "25-G" climb into the void surrounding the globe, the medical boys will know in advance exactly what acceleration the passengers can withstand.

They're finding out now with Hot Rod No. 1, a rocket sled that grinds to a slow-down 70 times as fast as an auto can, simulating the death-dealing forces of air crashes.

Eight Air Force volunteers at Edwards Air Base, Calif., have taken 47 bone-shaking rides on the fire-spouting vehicle. Parts of their bodies have been momentarily subjected to as much as 57 G of force—57 times the pull of gravity.

Object of the speed dashes and quick stops is to learn how many G the human body can take during acceleration or deceleration—negative acceleration, as in a crash—and to develop equipment to safeguard airmen and passengers in crashes.

Riding backward, with the seat to cushion your body, you can easily take 35 G, trials show. It's more rugged if you face forward. For airmen who must, the experiments have already yielded a life-saving development—a 250-square-inch harness of double nylon straps fastened to a lightweight aluminum seat strong enough to withstand 150 G. This may enable many a pilot to walk away from a crack-up.

Four modified Jato rockets propel Hot Rod No. 1, designed by Northrop Aircraft, Inc., along a 2,000-foot desert track. Its chrome-moly chassis mounts a passenger seat, a windshield, and telemetering equipment to transmit the readings of G-force gauges. Instead of wheels, it glides on aluminum-alloy slippers shaped to hold it to the rails. A slight aerodynamic lift as the sled gains speed reduces friction and eliminates the need for lubrication.

World's Most Powerful Brake

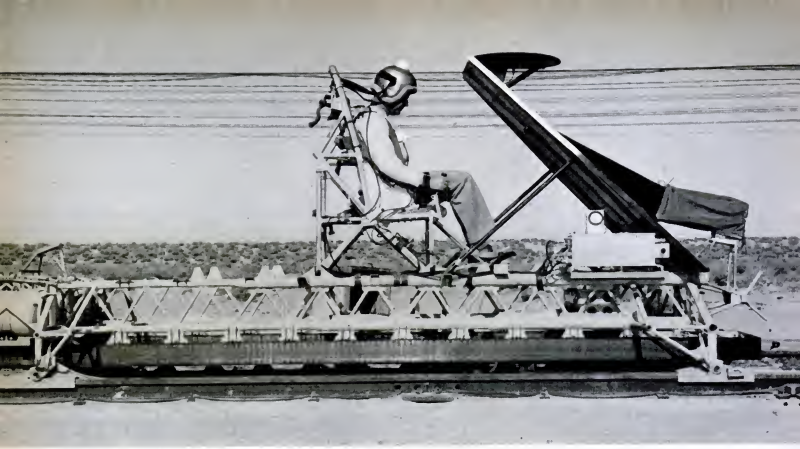
Racing at 150 m.p.h. or more, the 1,500-pound sled hits the most powerful brake in the world. Twice, eight sets of four brake shoes each clamp hard on two keel-like, armorplate runners under the sled. (In all there are 45 sets of four shoes that can be actuated.) They slow the sled in eight feet to a mere 70 m.p.h.

Rockets boost man-carrying sled to 150 m.p.h. for crash against world's most powerful brake. At right, automatic movie camera aboard tells story of how rider feels about it. From top to bottom, he's shown awaiting start; thrust backward by car's rocket-powered acceleration of 2.37 G; thrown forward as whole car quivers under 35-G impact of brake; straightening up as jolt ends and strain against straps eases; and grinning at end of the run, as he removes rubber mouth guard he wore to protect teeth.

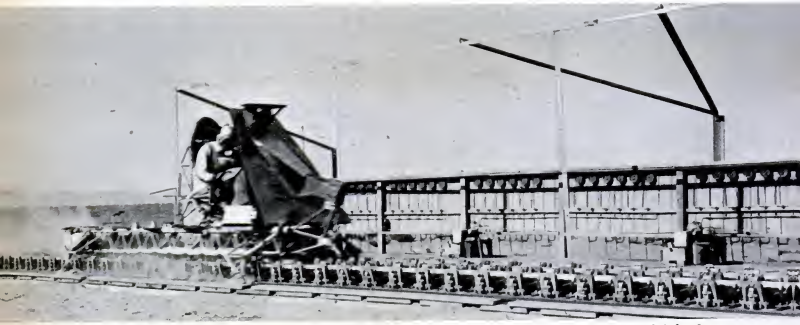
The result is the same as crashing a car at 75 m.p.h. into a barrier that stops it dead in nine feet! Then the sled coasts on, slowing more gradually. If it doesn't stop in the next 550 feet, it smacks a wire arresting cable that halts it near the end of the track.

How does it feel to take the ride? Says one volunteer: "Ever seen a man strapped in a chair waiting for a firing squad? Then you're off. You get a moderately good thump, and it's all over. Sweating out the start is worse than riding."

None of the volunteers has ridden with the brake set up really high. Captain G. tried it, though. Dashing Capt. G (G for gravity) is a 180-pound dummy shaped like a man. He was the rider when the sled plunged against the brake at 177 m.p.h. It got the whammy from 15 sets of brake shoes. The carriage ground to a dead stop in the next eight feet. But Capt. G. didn't. He carried away the windshield, hit the concrete 90 feet away, and skipped in a cloud of alkali 789 feet across the desert. That was 50 G of deceleration in action.

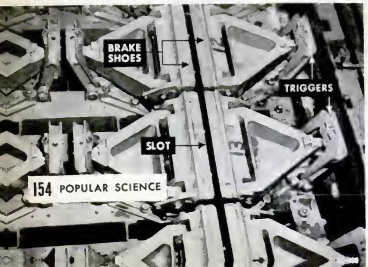


Muscles tense. Air Force volunteer awaits impact of rocket blast that will send car screaming down track. Circular platform atop windshield carries radio antenna that transmits data to trackside receiver. Camera within covering at right records subject's reactions. Track brake will grasp runner of armor plate seen along side of car just above rail of track.



Sled has reached full speed and coasts with rockets burned out as it hits braking section of track, above. World's most powerful brake slows it from 150 to 70 m.p.h. in 1/6 second.

Brake works like row of mousetraps. When cams on car hit U-shaped triggers, preset mechanism clamps brake shoes on runner. Shoes (below) are cast iron molded on steel.



Helpers strap rider in seat and adjust his crash helmet in preparation for a run. Gauges attached to his chest strap and helmet register the G-forces to which his body is subjected.

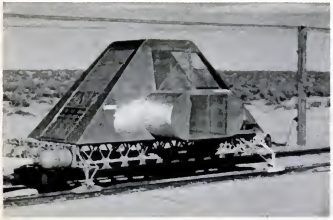
Last step before run is arming rockets. Electric igniter resembling spark plug fires rocket by touching off highly active pelleted powder. Its flames ignite solid-fuel propellant.

Braking section of track begins 1,250 feet from starting point of sled's run and is about 50 feet long. Slots of inner rails guide sled's braking runners between pairs of brakes.

Aircraft-type hydraulic pump supplies pressure used to actuate brake shoes. When all is ready, dials at top of picture will show pressure of 800-850 pounds per square inch.

Shockproof telemetering equipment on sled transmits four radio signals simultaneously during run. It is so rugged that it would keep right on working if kicked about like a football.

Film record, timing each part of run, is made by camera in trackside control room. Camera photographs signal lamps that light up as sled flashes past magnetic coils laid along track.



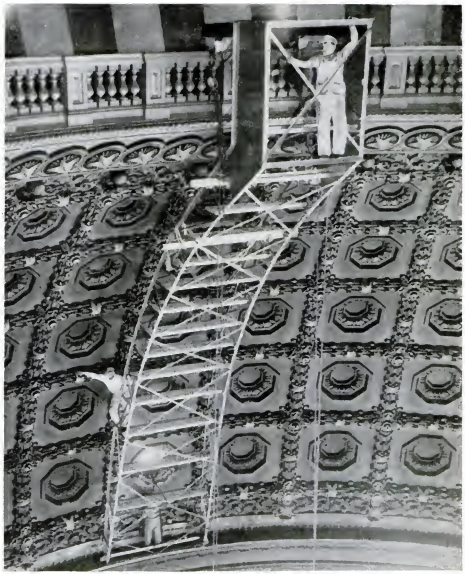
When first built, rocket sled had enclosed body as above and was called the "Gee Whiz." Experimenters later remodeled it to present open design, with windshield for passenger.

Arresting cable, near track's end, stops sled coasting into it after running past brake. Cable unreels from pair of hydraulically braked drums so as to provide shock-absorbing "give."

Capt. G., 180-pound dummy, had wildest ride of all on rocket sled. They gave him the works by braking sled from 177 m.p.h. to dead stop—and he took off on a solo flight all his own.

Curved Scaffold Fits Capitol Dome

THIS hanging scaffold (right) makes easy work of the previously awkward job of repainting the inside of the dome over the rotunda of the National Capitol in Washington, D. C. The new aluminum structure, specially designed for the Capitol, is suspended from the balcony railing, and curves to follow the contour of the dome. At the base are wheels that roll around a ledge 50 feet below the balcony. Fixed platforms spaced two to six feet apart, depending on the curvature of the dome, serve both as steps and working floors for the painters. The scaffold, designed by the Washington Aluminum Co., weighs less than 1,000 pounds.



Grass Seed Sprayed from Hose

ROLLING along Virginia highways, the truck shown above easily and quickly covers the steepest embankments with a spray of grass seed, water, and fertilizer. Using a tank from an old watering truck, an ancient ferryboat motor to power the pump, and an asphalt spreader for spraying, the unit, with a crew of three, can do a better job than 25 hand sowers. Grass sowing not only beautifies the highways, but prevents erosion.

How to Know Your Guided Missiles

U. S. GUIDED missiles have been given a new designation scheme by the Research and Development Board. With this system the RDB indicated the development of two interesting new types of missile: air-borne projectiles fired from beneath the ocean against ships, and similar ones directed against aerial targets.

In the new identification scheme, shown above, the first two letters are used to indicate the origin and destination. AAM is thus Air to Air. The M stands for Missile. These three letters would be followed by an additional service letter: A for Air Force, N for Navy, G for Army. Then comes a model number and a modification letter. If the missile is an experimental type, the designation is preceded by an X or Y.

Pilotless aircraft used as explosive-laden drones retain their own designations preceded by the letter M, meaning Missile Aircraft. Planes used as "mother" craft for the control of these drones or other kinds of missiles are prefixed by the letter D, for Director Aircraft.

Guided Missiles for research carry the designation TV for Test Vehicle. One of four prefix letters indicates the type of testing: L for Launching, C for Control, P for Propulsion, R for Research. The service letters and model numbers follow.—*James L. H. Peck.*

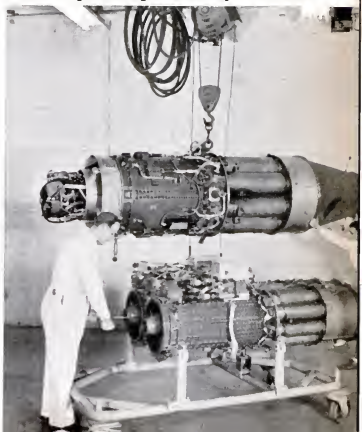
Dual Turbine Produces 5,500 Hp.

THE first real challenge given the British in the race for more powerful gas turbines for aircraft is pictured above—two engines mated to drive one contra-rotating-prop unit. The manufacturer, General Motors' Allison division, says the combination produces 5,500 hp. This is better than two horsepower for each pound of weight—roughly twice the power per pound of piston engines.

The power units, known as the T-40 series, were developed for the U. S. Navy. They will be used in a Douglas carrier-based attack plane, a Convair flying boat expected to have a top speed of 390 m.p.h., and a North American attack plane. Either engine in a pair can be run independently and each drives both props. This will permit full power for take-off and single-engine operation for maximum fuel economy.

The new American twin turbines are also adaptable for transport use. END

Extension shafts, above, run from paired gas turbines to reduction gearing for contra-rotating props. Below, note compactness of twin unit on stand compared to predecessor J-35 on hoist.



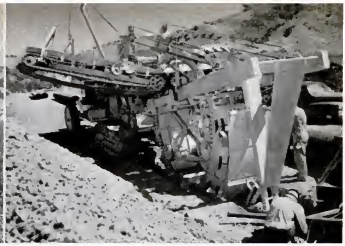
Rear view of 50-foot, wheel-type trencher shows size of bite taken by its steel jaws as it digs a mile of trench a day. Belt conveyer piles excavated earth along side of trench.

Mechanized Plumbers Lay Biggest Gas Pipe

THE giant machines seen in action here are making short work of laying a 34-inch pipe, the biggest ever fabricated for natural gas.

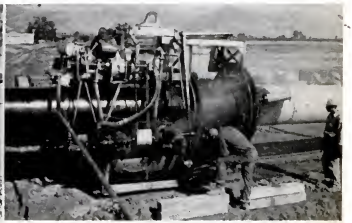
The 506-mile, $63,000,000 welded-steel tube forms California's new Super Inch pipeline, part of a 1,600-mile system that will go into service early next year. Its job will be carrying natural gas from Texas to northern California, where it will serve customers of the Pacific Gas and Electric Company.

Many of the machines were built to order for the record job. Others were rebuilt to make them big and powerful enough. Mightiest are a pair of trenching machines. Every day, each of these 50-foot, 32½-ton monsters digs a mile of trench 44 inches wide and 5½ feet deep. Then mechanical equipment applies a preservative wrapping to the pipe and lowers it gently into place.



Above-ground part of trencher is seen in these front and rear views. The 32½-ton, self-propelled machine travels on crawler treads at any one of 32 different speeds, obtained by various combinations of gearing. Normal 5½-foot depth of trench dug can be varied by raising or lowering wheel with cutting jaws. Maximum depth, attainable whenever wanted, is 8½ feet.

Self-propelled cleaning and priming machine rids pipe of scale and dust with contra-rotating steel brushes, then applies asphalt-base priming compound with revolving swabs.



Wrapping machine, also self-propelled, now coats pipe in turn with asphalt, asphalt-impregnated paper, more asphalt, and final wrapping of kraft paper in a continuous operation.

Side-boom tractors gently lower big pipe, with its preservative coating of asphalt and paper, into trench. Pipe will begin delivering natural gas to northern California in January, 1951.

Biggest Blasts Peel Mountains

When Tennessee Valley Authority engineers needed rock for two new dams, they just blew the sides off nearby mountains. One explosion—the largest construction blast on record—used 1,362,093 lb. of Nitramon.

The big blows were made by drilling many short "coyote tunnels" into the mountain face and filling each tunnel with explosive (right). Then the whole thing was set off at once.

Scientists took advantage of the explosions to measure how tremors travel through the earth's crust. Some of them were picked up by seismographs as far away as Ottawa, Ont.

Stick-On Letters Make Signs

Anybody can make neat signs with these plastic letters. Backed with adhesive, they stick to any smooth surface—but can be pulled off and used over and over again. Faulkner Laboratories, of Bradenton, Fla., makes them in several colors.

Weeds Plague Crystal Farmers

The technicians who "grow" synthetic crystals for telephone filters have weed troubles a little different from those of dirt farmers. The photo at left shows a typical "weed"—useless because it contains unwanted water molecules—that grew from an idle solution at Bell Telephone Labs.

Coated Gloves Won't Slip

A new type of work glove has a coating with a special Griptite® finish that helps prevent slipping. The Surety Rubber Co., Canton, Ohio, claims the new finish holds effectively even in lubricants, yet won't hurt metals or machinery.

Dressing Room in Fire Engine

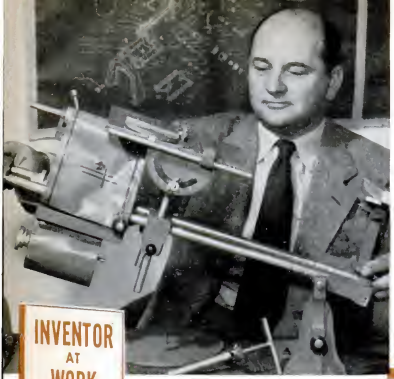
THESE British firemen don't have to stop to dress before starting for a fire—they dress on the way. Their new streamlined fire engine has a cabin behind the driver's seat large enough to accommodate the six-man crew. Shown above during tests at Ilford, London, the vehicle is powered by a 160-hp. engine and carries a 50-foot extension ladder.

Grinder Chews Up Light Bulbs

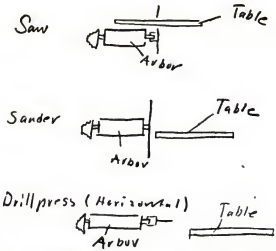
YOU can't just throw away a burned-out fluorescent light tube the way you do an ordinary bulb—the toxic beryllium powder remaining inside the tube, especially in the large quantity present when many tubes must be disposed of at the same time, is highly poisonous. For safe disposal, this grinder breaks the used glass tubes into small fragments that drop into a porous bag where a stream of water washes the dangerous chemical down a drain. The fragments are packed into tough-walled sacks for protection against cuts. Made by the Standard Equipment Co., of Chicago, the grinder can chew a tube in 10 seconds.

X-Ray Unit Has Wide Range

WITH this new all-purpose GE X-ray machine, doctors for the first time can treat a wide range of ailments with a single machine. Called the Maxitron 250, the unit can produce all ranges from the softest rays for skin treatments to the most penetrating for deep-seated cancers. Secret of its wide range lies in a new beryllium "window" that permits the same tube to produce both high- and low-intensity radiation. Weight has been reduced more than 700 pounds by use of gas instead of oil as insulation.



Moulin, San Francisco



Goldschmidt's own doodles show idea's development. Single arbor was saw, sander, drill, but big problem was to get it vertical. At left, inventor holds first crude mockup.

INVENTOR AT WORK

How the Shopsmith was "invented on purpose" as a work machine that made a power tool a household utility—and a howling sales success.

Dr. G's Motorized Tool Kit

By Andrew R. Boone and Perry Githens

PS photos by W. W. Morris and Hubert Luckett

EVER *fingered a safety pin, and said to yourself, "I wish I had invented that!" Or have you ever, by trial and try again, come up with a happy answer to some puzzling mechanical problem? No matter that a hundred other men have found the same solution under the same necessities: you are an inventor, and this is your story.*

Or perhaps you simply enjoy invention as a spectator sport. You cheered with Edison as he evolved his electric light, and with Whitney—Eli Whitney—the young Yankee schoolteacher, whose mind swept across a problem like wind around a steeple. Whose first sight of raw cotton mechanized separation of the seeds. And who fathered mass production, with interchangeable musket parts, long before Ford hitched it to power to turn out his automobiles.

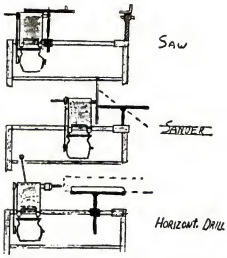
Then this is your story, too. For it is one of those rare case histories of invention complete from first gleam to final (and financial) success.

It is reported here, in full and for the first time, by PS Western Editor Boone from the factory in San Francisco, and by Editor Githens from his workshop in Westport, Conn.

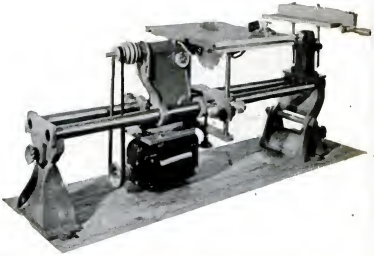
INTO Patterson Brothers, famous New York "department store for tools," rushed a man with a shopping list and a train to catch. Fascinated, he joined the crowd around a demonstrator who was putting a Shopsmith® through its paces—and missed his train.

Many a train has been missed, under

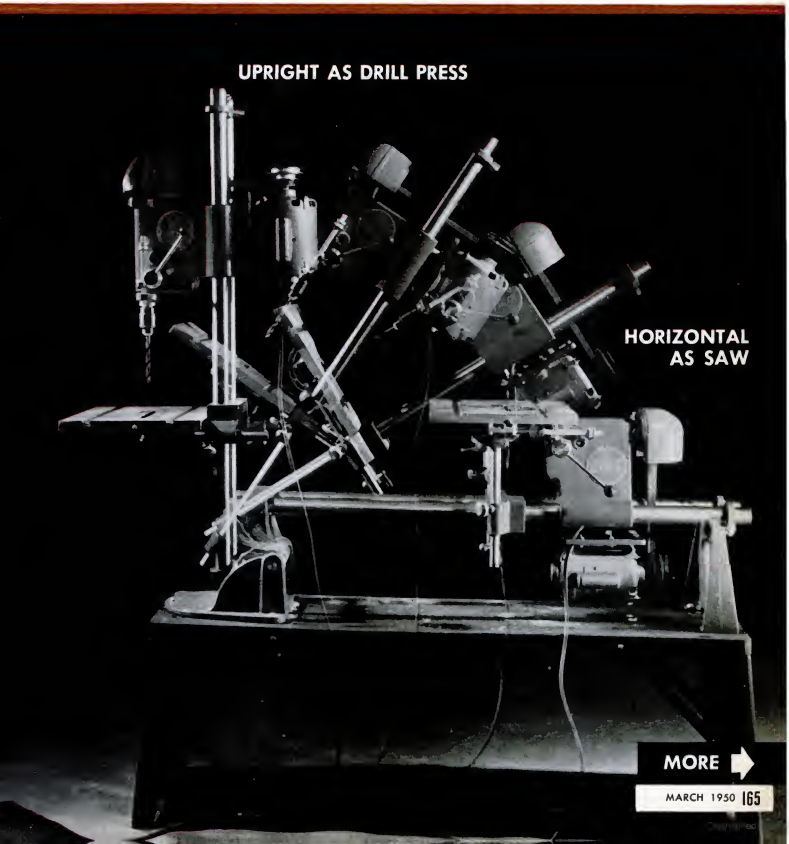
Multi-exposure photo at right shows how pivot permits quick change from vertical to horizontal. In practice, trick of sliding headstock toward pivot end to lessen weight makes job easy.



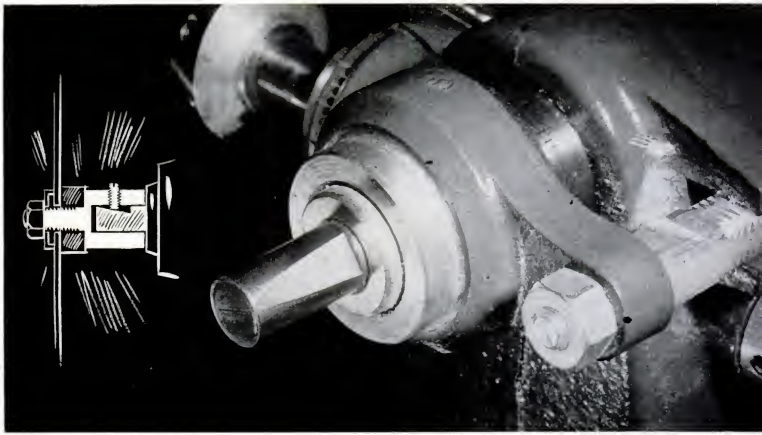
Turning point came, as later drawings show, when inventor hit on idea of pivoting end so machine could swing upright. Making headstock move instead of tailstock licked last problem.



First working model, assembled from scavenged parts and crude castings, looked like this. Note its close resemblance to final production model below, showing inventor's thoroughness.



MORE



The locking flat on arbor slopes inward, eliminating danger of blade or chuck flying off shaft at high speed. Even if locking screw loosens, fitting is held on tight, as drawing shows.

similar circumstances, by men whose skill is tried by a tack hammer. And many a spectator at these little Shopsmith shows has the hands that tell of a lifetime with tools. The only unusual thing about this particular man was that he already owned a Shopsmith and simply wanted fresh garnet paper for the sanding disk.

What makes the Shopsmith remarkable is not that it provides anything new in saws or sanders, but that it has wrapped up in one handy package all the most useful power tools. It has provided a basic work machine, adaptable to many tasks, that has become a household utility, like a washing machine or a mixer.

In fact, one husband who had to sell it to his wife in terms of its work, calls it his "mixmister" and uses it to mix dough with a bent rod in the Jacobs chuck. A plumber, building his own home, says it saved its cost in millwork on door and window frames. An airlines pilot, who hoisted a Shopsmith through a second-story window to floor and panel his "expansion attic," has now carried it down—over the stairs it cut—to make built-ins.

The Shopsmith was conceived as a unified power tool combining a bench saw, lathe, horizontal and vertical drill press, disk and drum sander. Attachments make it a jigsaw, shaper, jointer, mortiser, grinder, buffer, and rabbeter. And these chores it does well.

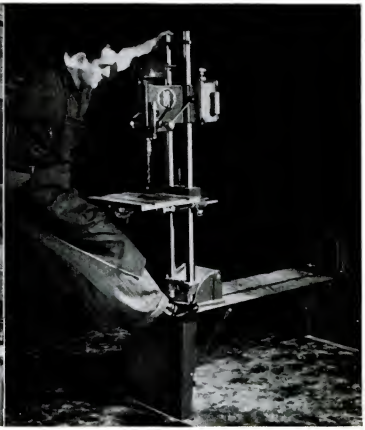
But its enthusiastic owners, who presumably also use it for woodworking, have gleefully adapted it to such unconventional tasks as cutting firewood (with an oversize saw set outboard), shining the whole family's shoes (with a sheepskin muff on the drum sander), churning butter, freezing ice cream, spinning metal bowls, and cutting sheet steel. Also mixing paint, whipping potatoes, cleaning paint brushes, scouring pots (with flexible-shaft attachment) and running a milking machine. No one has yet reported using it as a washing machine or a dental drill, but one dentist made all the cabinets for his office with it—and the Shopsmith is still young.

50,000 Sold in Two Years

For in a little over two years, this newcomer in the crowded field of power tools for the home workshop has quietly achieved spectacular success. Some 50,000 Shopsmiths have been bought to the tune of a $10,000,000 total.

To the industry, this is both a shock and a hope. A shock to which some traditional tool manufacturers have already responded with combinations of their own good tools

Tubular ways are rugged and rigidly parallel. They went through this strength test unharmed.



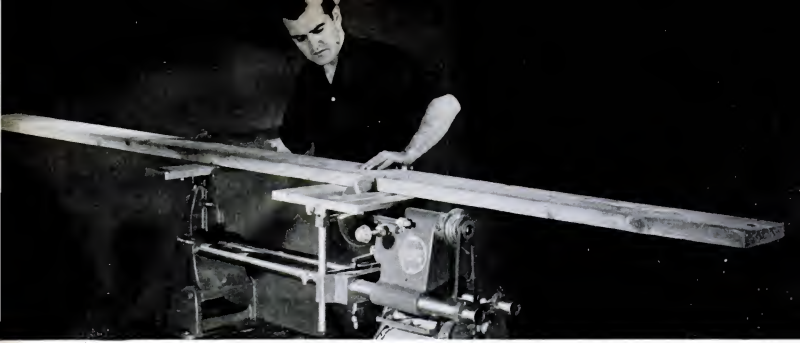
Well-balanced, even in upright position, the 200-lb. tool withstands yank of 170-lb. man.

neatly arranged on a bench. A hope, in the realization by the trade that probably most Shopsmith sales represent fresh converts to the home-workshop idea. Logically, few Shopsmith buyers already owned a power saw, lathe, or drill press. In the beginning, the expert amateurs and high-skilled hobbyists were quite cool to the very idea of a combination power tool. There have been combinations before, and most of them have been like the wondrous jack-of-all-knives that can do anything—and nothing well.

But the Shopsmith was not just a combination: it was conceived, thought out, invented and developed as a *single tool unit* with *multiple-use* in mind. It did not be-

Four ball bearings in arbor give tool unusually smooth, quiet operation. Using quill to position saw blade allows fine adjustments, permits dado cutting without special blade or washers.

Coins stand on edge while blade whirls at full speed, showing tool is virtually vibrationless due to precision construction, ball bearings, and rigidity of ways. Motor is ½ hp., 1,725 r.p.m.



Sawing long boards like this 12-footer is no problem with extension table mounted on tail-stock. Other extensions make table 23" by 55". With 8" blade, maximum depth of cut is 2¼".

Horizontal drill-press position permits drilling of stock far too large for conventional drill press. Note that quill can be operated from either side of tool by simply changing the lever.

Need to saw large, heavy pieces? Just up-end saw and feed work vertically. Guide for bottom edge is plank on floor. Pressing work against table keeps it flat and the cut straight.

gin, like the automobile, as a buggy with an engine to turn existing wheels. It began, like the jet plane, with a fresh concept.

It began with the personal necessity of an industrial engineer who fled his native Germany in 1937, and who found his thoughts could flourish in a land where "Yankee ingenuity" was more a matter of residence than birth.

Hans Goldschmidt is an unspectacular man you would take for granted in a meeting of scientists, in a mechanic's coveralls, or in the smoking car of a suburban train. He is a Ph.D. (he obtained his degree at the University of Berlin) who does not want to be called "Doctor."

Wanted to "Invent Something"

Hardly five years ago, Hans Goldschmidt was working in the Kaiser yards at Richmond, California, helping to clip the minutes and motions that made Richmond famous for quick ships. With the war all but won, he thought of peace—and the need of a job. This was the necessity that mothered this invention.

For Goldschmidt set out, quite deliberately, to "invent something" that would win him a living in a peacetime world where industrial engineers, however skilled in time and motion studies, would be a dime a dozen. He confided this firm intention to his immediate boss, one Robert L. Chambers, who was equally uninhibited about ideas.

With the war's end, Goldschmidt got himself a job as foreman in a Berkeley woodworking shop. There, watching the men and the machines, he found the answer to

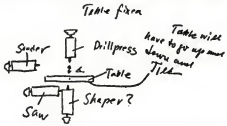
what he wanted to invent. He knew nothing of machine design, next to nothing of traditional woodworking methods, and less than nothing of the passionate personal interest of the home workshopper. But he knew production and people. He studied, dispassionately and impersonally, the way of a man with a woodworking machine, and the needs and uses for tools powered to make things easily and quickly.

"I found," he says, "considerable duplication in single-purpose tools. If a multipurpose tool could use the same parts, I was certain it would be widely accepted."

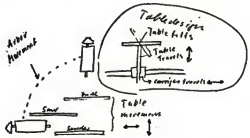
With that he set out to invent a "multipurpose tool." He doodled a circular saw first, of course. Now, he sketched to himself, replace the blade with a disk—like this—and there's your sander . . . substitute a chuck and there's your drill press.

He noted that saw, sander, and drill had two things in common: a table to hold the work, and an arbor and clamping device to hold the tool on the revolving shaft. He put aside, for the moment, the problem of the lathe that cuts whirling wood into round bowls and baseball bats.

First, he doodled, try keeping the table stationary and moving the arbor, like this:



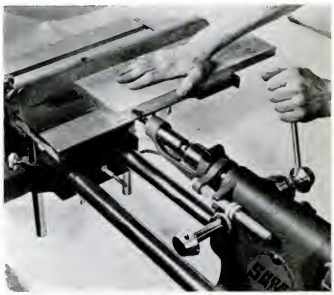
Not so good? Then try a fixed arbor and move the table into position for saw and sander, like this:



That meant swinging the arbor from horizontal to vertical to make a drill press. But how? Goldschmidt pivoted his pencil on the sketch pad. Slowly the answers came . . . mount the table on a rod . . . set the rod in a carriage . . . move the carriage back and forth on a tube supported at both ends. . . .

Now the hounds of the mind were circling for the scent. Why not mount the

With special fence and attachments, tool can be used to shape, as shown above, or joint, rabbet, and mortise. Different-sized table inserts permit various tools to fit through table.



Here tool is rigged to mortise on horizontal with rip fence as stop. Gauge insures accurate depth of cut. Fence has similar gauge for precise sawing. Photos above by Moulin, San Francisco.

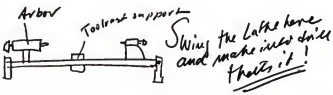
Jigsaw attachment slips over arbor, fastens to headstock with single screw. Aluminum yoke has 18" throat. Two-piece construction lets arm come off for saber-blade work on large pieces.

arbor on the tube, too, and swing the whole business from horizontal to vertical? The hounds gave tongue.

So far, Goldschmidt had dreamed up with pencil and paper a machine with motor and arbor in a headstock mounted on one end of a tubular "way," the other end of which was pivoted on a base plate. The carriage for the table could be locked anywhere along the way. The table could be raised, lowered, and tilted. All that was needed to make a lathe was a tailstock.

But in the vertical drill-press position, the headstock could not be adjusted. The sander worked sideways, but not so you could face the disk. The single tubular way would make it hard to line up carriage, headstock, and tailstock quickly and accurately.

Here the dogs of thought closed in for the kill. Goldschmidt made a succession of important decisions. First, he departed from conventional lathe design and made the tailstock fixed, and the headstock movable. This let the drill-press height be adjustable, like this:

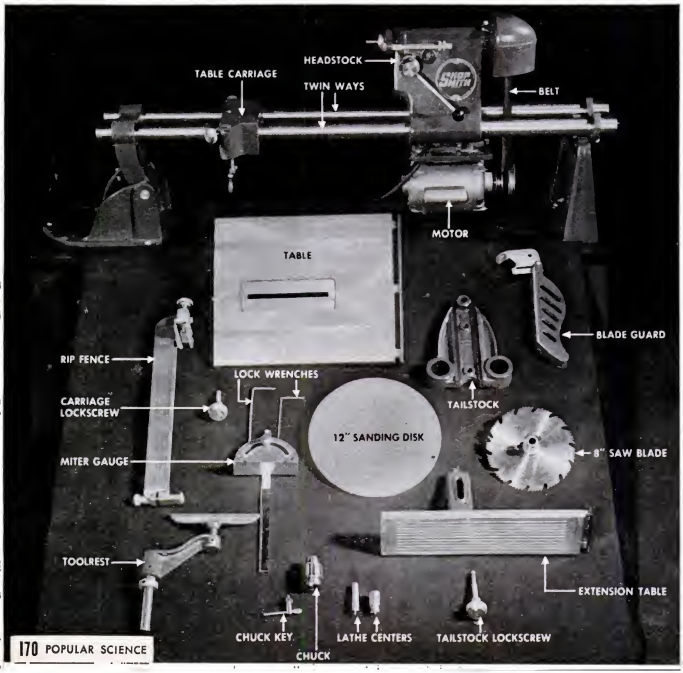


Next, he decided on using *two* tubular ways for maximum rigidity, ease of use, and production economy. The rest was details . . . the arbor designed to feed out as in conventional drill-press design . . . the table rethought to provide miter gauge and rip fence . . . the tailstock made removable, and adjustable to hold a table extension.

Up to now, Goldschmidt had been doing mental inventing, testing problem and approach only with pencil and paper. By late 1946, the Ph.D. with the thinking pencil was ready to turn tool designer.

With wood, cloth, and paper, he made a

Basic $199.50 package includes everything for sawing, sanding, drilling, turning. Jigsaw, speed changer, and tools for jointing, shaping, and mortising are some of extras available.



Lock a bent rod in drill chuck and you've got a powerful mixer that will mash potatoes, churn butter, beat heavy batter. Inserted through paint-can lid, rod does fine job of mixing paint.

Cutting firewood, or other thick stock, is simple with this setup. With saw outside table, blades up to 15" can be used. One owner devised a cradle for greater safety and convenience.

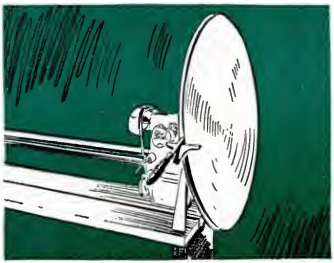
half-scale mockup to try operating principles in simulated uses. The proof of this simulated pudding is that the mockup looks remarkably like the actual Shopsmith as finally produced in steel and aluminum.

Then came a working model, a lash-up of scavenged parts, a couple of crude castings, and plenty of whittled wood. But it worked as Goldschmidt's pencil said it would. His invention was invented, and it was time to tell his friend Chambers.

Chambers took one look and sent for his brother Frank, a Harvard Business graduate who got his merchandising training at Macy's. At their second meeting with Hans Goldschmidt, Bob and Frank Chambers agreed to finance the Shopsmith.

The prototype, gleaming with real steel, was ready in July 1947, almost before the blueprints were dry. The Chambers brothers had raised the money, formed a company called Magna Engineering Corporation, and christened the product Shopsmith. They had also applied their sharpest pencils to manufacturing costs, and had made their first big sale: 250 units to Montgomery Ward, to be delivered by November 15th.

Today, the three men own the company. They are proud of the success of Shopsmith, and busy with ideas for accessories and new products still unnamed. Perhaps the happiest is Hans Goldschmidt who sat down to "invent something" that would make him a living—and did both very well. END



For super-large turnings, slide headstock off ways, reverse direction, and put it back so arbor overhangs end of bench. This way, distance from spindle to floor is only limit on diameter.

Shining family's shoes with fleece muff is one of many tricks Shopsmith will do. For delicate or hard-to-reach jobs, flexible shaft can be attached to take grinders, buffers, brushes, drills.

Aids to Modern Living

Steel Pan Has Aluminum Bottom. A ⅛-inch aluminum bottom bonded to this stainless-steel saucepan is said to lessen scorching of food by eliminating "hot spots" in the pan. Stainless steel is used because it retains heat and is easy to clean. The price is $4 to $12, depending on the piece, from S. W. Farber, New York City.

Wash Line Rolls Up. When not in use this double clothesline rolls out of sight into a metal holder attached to the wall. When wash is to be hung up, the line can be pulled out and hooked to an opposite wall. A turn of a plastic knob tightens and locks it. The device is sold by Hoge and Grenn, New York City, for $5.25.

Bacon and Egg Fryer. A new skillet keeps cooked bacon strips hot on a special warming apron while eggs are cooking. During bacon-frying, a cover grill holds strips flat, cooking both sides at once. A ring drain around the pan's frying surface catches fat. The skillet is available from the Everedy Co., Frederick, Md., for about $3.

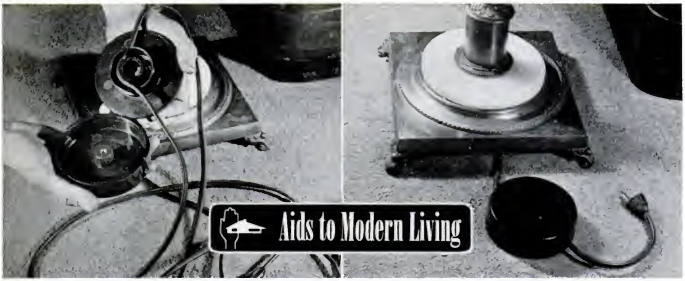
Flexible Kitchen Knife. Designed as a kitchen tool, this flexible knife lets you saw frozen foods, bones, or bread. Being made of tempered bandsaw-blade steel, it can also be used to cut plaster, wood, and metals. Priced at 89 cents, the rustproof knife is distributed by Walter Drake, of Colorado Springs, Colo.

Humidifier Holds Plants. This decorative plant bowl is also a humidifier that keeps room air moist. Water poured into the base rises by capillary action to the top of two porous evaporators, which are made of specially compounded ceramic materials. Mois'n-Air® is sold by the Puritan Sales Co., of Atlanta, Ga., for about $5.

Clothes Rack Saves Space. If you hook a rack like this over your closet door, you will have more clothes-hanging space. Extended, the rack holds 10 garments; folded flat against the door, it occupies the space of only two. A suction cup holds on the lower part. Nu-Products Co., of New York City, sells it for $1.50.

Sponge Is Brush. The brush above can be used on clothes, dishes, or in the bath. Unlike fiber brushes, it can be wrung out like a cloth. Available in three sizes, it costs from 89 cents to $1.69. The device has a plastic handle that is removable for cleaning. Moser-Keenan Co., of Portland, Ore., is the manufacturer.

Washboard Fits Hand. Stubborn dirt stains can be rubbed out of small laundry items when you use this pint-size sheet-aluminum washboard, which can be held comfortably in the hand. Tied to the washing machine, the board serves as an auxiliary aid on washday. Vic Products, Inc., of Fenton, Mo., sells it for 25 cents.



Box Holds Outlet Cord. If stored in this container, excess lamp and fixture cord won't clutter the floor. You remove the top of the circular plastic box, place the cord across the bottom section, as at left above, screw on the top, and twist to wind in the cord. Made by Eypper & Co., of New York City, Reel-Away® costs 69 cents.

Can Opener Does Eight Jobs. Bristling with attachments, this new gadget is armament for assault on eight different kinds of containers. It pries off caps and lids; it helps turn stubborn screw caps of all sizes; it shears off can tops; and it punches milk and beer cans. Priced at $2.95 by Pretorius Approved Products, of Glendale, Calif.

Plastic Holds Hook to Wall. To attach this hook to a wall, the spongy pad on its back is dampened with carbon tetrachloride, contained in a special capsule. This dissolves the polystyrene plastic resin impregnated in the pad, causing the device to stick wherever fastened. It is made by Household Aids, Inc., Rochelle Park, N. J.

Spatula Grips Food. Stainless-steel jaws on this spatula hold fish, meat, or pancakes firm while they are turned in the frying pan, preventing grease from spattering. Pressing a thumb plate (arrow) on the handle opens the clamp. The spatula is available from Buckly Culinary Products, of Chicago, for $1.

Clock Keeps Running. If house current is cut off, a clutch inside this electric clock instantly activates a spring-driven balance wheel. The clockwork drive will run it for 30 hours. When current is restored, energized magnets stop the balance wheel, and the motor runs it. Eunice Novelties, Inc., New York City, prices it at $15.

Keeping the Home Shipshape

A tie rack for a closet door can be made from a length of flat curtain rod—the kind that telescopes. Bend the rod as shown and tack or screw it inside the closet door.

For cleaning: Leave part of the lid of a No. 3 can uncut. Bend the lid so the can will hang on the side of a scrub pail. It will carry cleaner to wipe off door frames and window sills.

When painting window woodwork, use wet newspaper to keep drips off the panes. Cut newspaper to exact size, soak it in water for a few seconds, and smooth it onto the glass.

It's easy to dress up an old iron bedstead. Make slip covers to fit over the head and foot. Patch pockets on the headpiece are handy. They'll hold magazines, a watch, or glasses.

For the housewife who sews, a ruler on the blades of scissors is a real help. Using a ruler, mark on the inch and half-inch marks with bright-colored nail polish as shown.

Please turn the page for five more suggestions

Keeping the Home Shipshape

Aluminum foil placed under ice-cube trays keeps them from sticking. Unlike wax paper, which can also be used for this purpose, aluminum foil can be used over and over again.

Coat the bottom of your kitchen garbage pail with melted beeswax to prevent rusting. The wax melts at about 145° F. Washing the pail with fairly warm water won't soften the wax.

To prevent moisture from entering a roll of stamps, labels, or gummed paper and causing sticking, rub a candle on both sides of the roll. This will help make the roll moistureproof.

Use a large paper bag as a dust trap when shaking out an oil mop. Put the mop head in the bag, tie the bag's neck with string, and shake. Then you can discard bag and dust.

A small playpen with a detachable bottom can be used as an emergency crib. Place the pen on a bed after removing the bottom. Anchor it with strong tapes pinned or tied to the bed.

Mechanics and Handicraft

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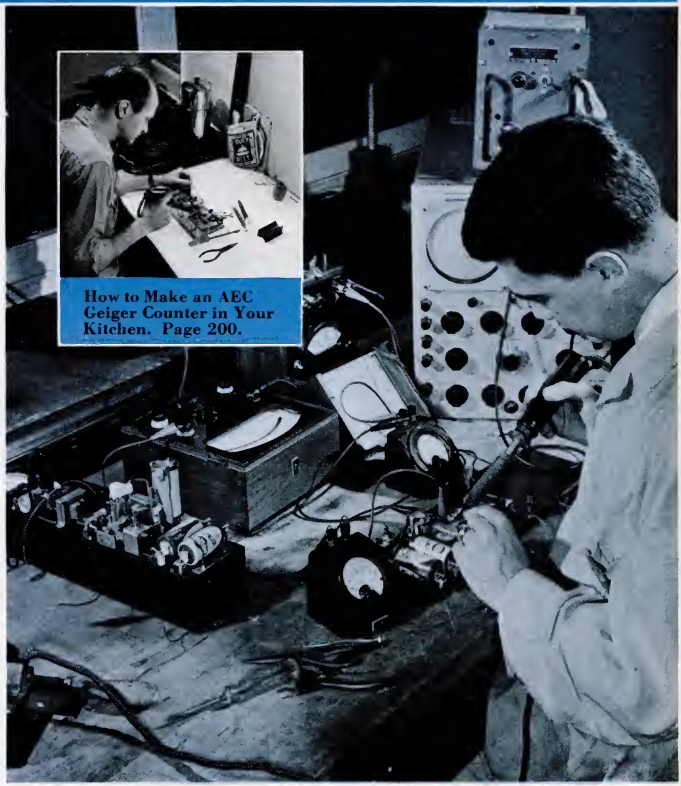
Make Your Yard a Playground PAGE 205

Time-Savers for Woodworkers PAGE 216

Plans for a Midget Hot Rod PAGE 221

Installing a 16-Inch TV Tube PAGE 229



How to Make an AEC Geiger Counter in Your Kitchen. Page 200.

Gus and

the Popping Filler Cap

Police Sergeant Corcoran, hunting a thug whose dark sedan left a scarred track in the mud, gets an unexpected lift at the Model Garage. ***By Martin Bunn***

GUS WILSON looked up from the dismantled fuel pump on his workbench as Jerry Corcoran strode briskly into the Model Garage, came to a heel-clicking stop, and saluted smartly. "Hello, Jerry," Gus greeted. "Practicing for a pee-rade?"

"Jerry be darned," the state policeman said. He cocked his head down toward the brand-new chevrons on his sleeve and grinned. "Sergeant Corcoran, to you!"

Gus stuck out a cordial hand. "They look swell!" he said. "You had them coming."

"Took me long enough to get 'em," Jerry said. "Now they're apt to have 'em off me before I have a chance to get used to 'em!"

Gus laughed. "What's biting you?"

Jerry pushed his broad-brimmed felt hat back on his head and pawed in the breast pocket of his tunic for cigarettes. There wasn't any smile on his brown face now, nor in his keen gray eyes. "Hear about Jim Zugsmith?" he demanded.

"Fellow who runs the gas station at Four Corners?" Gus asked. "What about him?"

"Fractured skull," Jerry stated. "The docs figure he has a fifty-fifty chance—no better. Stick-up job last night, around ten o'clock. The guy got away with about fifty bucks."

"Not much to risk the chair for," Gus said. "I'm sorry about Zugsmith. Got a line on who did it? Or shouldn't I ask, now you're up there with the big brass?"

"Look out—there's a man under there!" Gus shouted, as the customer started to back out.

—RAY QUIGLEY—

Jerry didn't smile. "This is my first case as a sergeant," he said, "and I need to get results. You know how the newspapers will ride us. Probably call it a wave of rural crime . . . No, we haven't got much of a line. Jim was alone, and didn't see the guy who slugged him. He had dozed off in the office. Horn woke him up, and he saw a car standing at the pump—all he noticed was it was a dark sedan. Soon as he stepped out of the door someone conked him. When he came to half an hour later he managed to make it to the phone. Then we got on the job."

"But couldn't get anything?" Gus asked.

"Well," Jerry told him, "we did manage to turn up something—not that it's likely to help much. It rained about eight o'clock last night. Jim figured it would freeze, so he sprinkled sand on the concrete apron around his gas pumps. It didn't freeze, and we found some tire tracks in the wet sand." He extracted a photograph from an inside pocket. "Here's the only one that counts," he said.

"Tread isn't much worn," Gus commented after he had examined the photograph carefully, "but there's quite a cut across it."

Jerry nodded. "You and Stan keep your eyes open for a tire with a cut like that on its tread, will you?" he asked. "If you should spot one, get the license number and give us a quick call . . . Oh, there's one other thing. You know where Zugsmith's station is—where the dirt road to Springvale crosses the hard-surface road? Well, we picked up that tire track in the mud of the dirt road and followed it. The guy drove about a mile toward Springvale, and then turned around—backed into the ditch doing it—and came back to the hard-top. I figure he lost his way—probably doesn't know much about this part of the world."

Gus handed the print back. "Okay, Jerry," he agreed. "We'll keep an eye out for a tire with a big cut across its tread, on a car driven by someone who is a stranger around here. But it doesn't look very hopeful."

"You're telling me!" Jerry growled.

Most of a week went by without Jerry showing up again at the Model Garage. Gus could guess why—the new sergeant was too busy. Jim Zugsmith had turned a sharp corner, was on the road back, and had been pretty well forgotten by the newspapers, which were playing up later exploits of the same thug. Never seen by his victims, he'd already slugged and robbed the operators of three other isolated filling stations within a ten-mile radius of town.

Wilson & Hicks, Private Eyes

Gus and Stan Hicks between them managed to get a close look at the tires of every car driven by a stranger that had been brought into the shop or even had stopped at the pump for gas. But not one of the tires they'd seen had carried a scar anything like the one in the photograph.

Late one morning, while Gus was in the office talking to his partner, Joe, Stan rushed in. "This one's sort of funny, boss," Stan said, indicating a car that had just entered the shop. "The feller claims the cap on his

Pontiac Eases Tappet Repair, Stops Tool Rattle

MECHANICS who have had to feel blindly for the tappets of an L-head engine with their wrenches while adjusting for lash will welcome an innovation by Pontiac. Remove the right front wheel, open an access door on the inside of the fender, and tappets can be fixed in plain sight and more accurately.

Pontiac also has done something about that noise in the luggage compartment of the family car as the jack, lug wrench, and assorted other tools bounce around with each bump on the road. This year's models have coil-spring tool holders that help stop the clatter of all such accessories.

oil-filler tube keeps poppin' off. I never ran into that one before. You better take a look."

"Did you sleuth his tires?" Joe Clark demanded. He'd been kidding Stan and Gus about their futile detective work.

Stan grinned. "Yes—but this time I didn't need to," he said. "The feller's a minister."

In the shop Gus found a stubby man, wearing a dark-gray suit, a soft black hat, and a clerical collar, frowning at a middle-aged sedan.

"The reverend says—" Stan began.

He was stopped by the customer's upraised hand. "I'm not a clergyman," he said deprecatingly. "Just a humble worker in the vineyard. But my duties demand a considerable degree of mobility, so any trouble with my car is of serious moment to me." He looked at Gus with smouldering dark eyes. "I want it fixed—quick!"

"Oh?" Gus said. Then he smiled. "We'll have to find out what's causing the popping off, before we can stop it." He removed the filler cap and examined it carefully.

"Ever have this thing cleaned?" Gus asked. The customer shook his head. "I thought not," Gus continued. "The job should be done regularly—during a tune-up is a good time. It's pretty nearly as important as cleaning the carburetor air filter."

Gus pointed to the wire mesh visible through the side of the cap. "See, here's what I mean. This filter is so choked up with dust, dirt, and other gook that I doubt if *any* air can get through. Let's see what happens." He replaced the cap, got into the car, and started up the engine. "Sing out if she pops off," he told Stan.

While Stan watched, Gus ran the engine at varying speeds for a few minutes. Then Stan suddenly raised his voice above the engine's noise. "Thar she blows!" he yelled.

Shutting off the engine, Gus got out and picked up the cap. "That's part of the trouble, anyway," he said, handing the cap to Stan. "Wash it out, will you?"

The sedan's owner had been growing increasingly fidgety. "I'm in a hurry!" he snapped. "If you can't find out what's the matter with my car I'll take it—"

Gus didn't hear him. He had slid under the sedan and was examining the back-pointing crankcase ventilator tube that extended down under the car. After a moment he fished a screwdriver out of his coverall pocket, dug something from the mouth of the tube, and rolled it between forefinger and thumb. He whistled softly as he lay on his back for a moment, doing some fast thinking. Then he wriggled out and straightened up.

"I think I've found the cause of your trouble," he told the owner. He stooped down again. "Look here, Stan, will you?" Stan got down beside him. "Get under the car and make a noise as if you were working on the crankcase," Gus whispered. "Don't ask questions—do as I say! Stall until I come back!" He got up again. "It's the crankcase," he told the car's fidgety owner. "I'll have to get a couple of odd-size machine screws out of the stockroom."

Red Clay Gives Clue

He hurried into the office, closed the door behind him, and dialed the State Police substation. "Sergeant Corcoran there?" he asked, his eyes on the office door. "Put him on quick, will you? . . . Hello, Jerry. What color is the mud on the Springvale dirt road—do you know? . . . No, I'm *not* kidding! . . . Red clay, hey! About the only red clay right around here, isn't it? . . . Thought so! Come over here—fast! I think the guy who slugged Jim is in the shop—he's dressed up like a minister. I'm faking a repair job, but he's getting impatient. Step on it!"

He went back into the shop. The clerically dressed customer scowled at him. "Get a move on!" he rasped.

"Okay," Gus said meekly. "I'll have you fixed up in a few minutes." He

reached a hand under the car. "Here are those screws, Stan. Hurry it up, will you?"

Gus started to tell the impatient customer a trumped-up story about what was the matter with his car. He hadn't got far when a siren wailed briefly down the highway. The stubby man started, then jumped into the sedan and stepped on the starter. "Look out—there's a man under there!" Gus shouted.

The driver paid no attention. As Stan scuttled crablike to safety, the customer started to back the car out of the shop.

But he was too late. The door opened and Jerry Corcoran and another state trooper hurried in. The instant Jerry saw the clerically dressed driver he went for his gun. "Reach 'em up, Parson!" he said. "Quick!"

The sedan's owner hesitated for a split second; then he got out with his hands held shoulder high. "Look him over, Frank," Jerry said, not lowering his gun. "It's Parson Strauss—he's a bad one. No more a parson than I am."

The trooper's practiced hands ran over the man's coat. Then he held up an automatic and a lead-loaded blackjack. "Put the bracelets on him," Jerry ordered. He turned to Gus. "What goes on?"

Gus told him about the popping filler cap. "When I found the screen stopped up, it was plain what was wrong. Normally, air enters through the cap screen, picks up the vapor in the crankcase, and is sucked out through the ventilator tube underneath the car. Since the cap was being kicked off, I figured a lot of back pressure must be building up, probably from blow-by because of bad rings. But back pressure that strong could only build up if the ventilator tube was stopped up, too. So I looked."

Mud Plug Traps Mug

Gus held out a chunk of red clay. "Here's what I found. Still plenty in there. The mouth of the tube slants to the rear of the car, so the only way I could figure it could have got plugged that way was by the car being backed into a bank of clay, or along a dirt road that had deep ruts in it. Then I remembered what you had said about the guy who had slugged Jim driving toward Springvale and then backing into a ditch. That would account for the clay plug in the ventilator tube—and the Springvale road is the only red-clay one around here."

The prisoner laughed. "That hooey will get you a long way with a jury!"

"Take him out to the car, Frank," Jerry directed. Then he turned to Gus. "He's right," he conceded, "but with that scar on the tire tread to back it up—"

"There isn't any scar on any of his treads," Stan cut in.

Jerry looked blank for a second. "He got wise and changed tires," he guessed. "Hope he didn't get rid of the old one. Let's have his keys." He opened the luggage compartment, and they got out the spare tire. Its tread had a wide cut on the tread.

"That'll do it," he said. He looked down contentedly at his new sergeant's stripes. "Guess they'll leave 'em on me, after all—thanks to you, Gus!" END

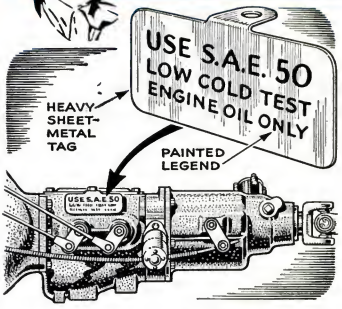
Fender Guide Lights Up

A NEW type of marker, which glows at night, for that invisible right fender is announced by the Santay Corp., Chicago. Called the Flame Tip Fender Guide®, it uses a light-piping Lucite® shaft. A bulb in the base lights up a flamelike upper end.

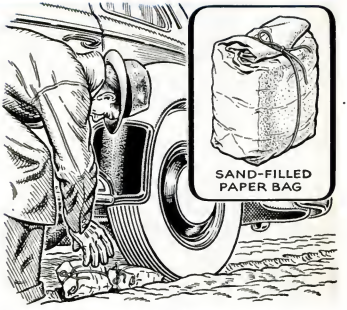
Auto Oven Cooks Hot Dogs

WANT a hot dog on the road? Just plug this heater into your car's electrical system. It cooks two wieners in three to five minutes. Priced at $3.95, it also comes in a 115-volt version for the home. It is called the Hot Dog Sizzler® and is made by the Thomas Manufacturing Co., of Chicago.

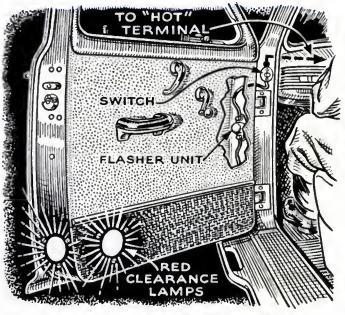
Hints from the Model Garage



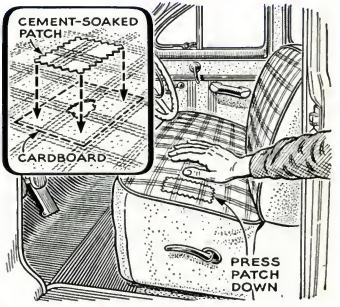
Tag Shows Proper Lubricant. In some new cars, a heavy motor oil is specified for the transmission instead of grease. To prevent careless errors, paint the oil recommendation on a metal tag and attach it near the transmission filler plug.



Sand "Bombs" Overcome Ice. If you frequently must drive on ice, keep sand in your luggage compartment, packaged in paper bags tied with string. Carry the bags in a cardboard box. Then, when stuck, drop bags under the rear wheels.



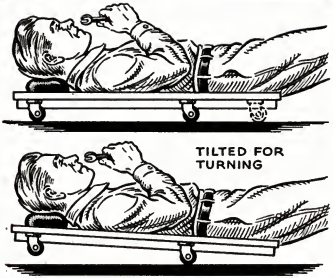
Door Lights Flash Warning. Before getting out the driver's door in traffic, it's always a good idea to look both ways. John W. Bell, of Des Moines, Iowa, has provided additional safety with this warning system. When the door is opened, a normally-off push switch in the door jamb shoots current to the flasher unit. An auxiliary switch on the dash cuts off the system if you want to keep the door open.



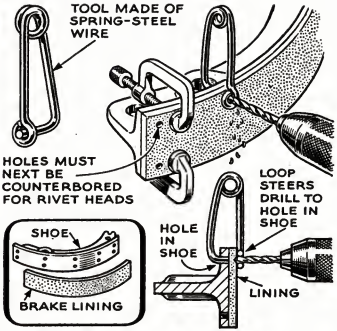
Patching Seat Covers. You can repair a worn area or tear in fiber seat covers by cementing on a patch. Cut the patch from a hidden part of the cover, using pinking shears if available. Put cardboard between the worn area and the upholstery to protect the latter, saturate the patch with clear model-airplane cement, wait until it is tacky, and press firmly in place. Let the patch dry overnight.

Turn the page, please, for four more auto hints

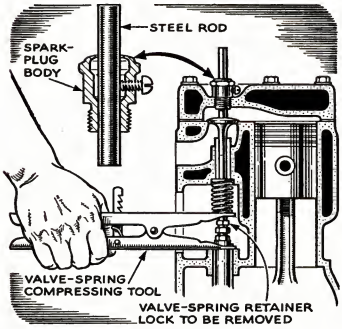
MORE Hints from the Model Garage



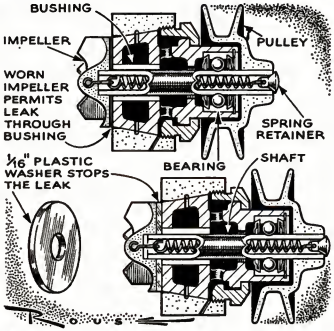
Turn Creeper by Tilting. On rough garage floors, it's often difficult to turn the usual shop creeper when you want to move to a new position. The creeper will work better if you set one pair of wheels back 12″ or so from the end. Then, by shifting your weight, you can tilt the creeper slightly when you want to turn.



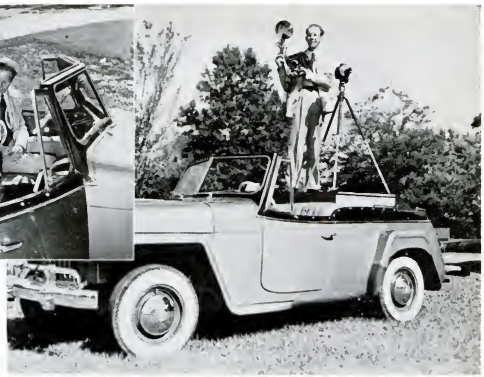
Aligning Holes in Lining. If you cut and fit lining to brake shoes, this tool will help you align the rivet holes in the lining. After the lining has been cut, attach it securely to the shoe. Then place the prong of the tool in the shoe rivet hole and drill through the tool eye. Counterbore for the rivet heads.



Replacing Valve Springs. This tool makes it easier to replace an intake-valve spring on an L-head engine without removing the head. It's used by adjusting the steel rod until it bears on the head of the closed valve. Turn the body into the spark-plug hole without forcing it. The spring can now be compressed and the retaining key removed. Marion L. Rhodes, Knightstown, Ind., developed the tool.



Washer Tightens Worn Pump. In overhauling a Ford "60" water pump, John Salzillo, of Brooklyn, N. Y., found that the edge of the plastic impeller had worn so much that the spring couldn't pull it snug against the pump housing. To take up the slack, he removed the impeller, and slipped a plastic washer on the shaft. This had the effect of building up the worn impeller. He cut the washer from 1/16″ plastic.



Car Gives Photographer High Eye

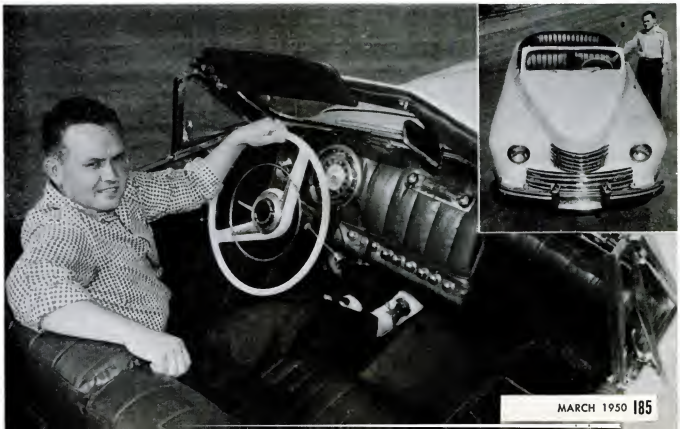
PRESS photographers often have difficulty getting high enough to shoot over crowds and other obstacles. Langston McEachern, of Shreveport, La., has solved this problem by installing a combination platform and equipment cabinet in his Jeepster.

Compartments and drawers in the 30″ by 30″ by 40″ wood cabinet allow plenty of room for his holders, flash bulbs, tripod, camera, and miscellaneous equipment. A sponge-rubber lining protects the equipment from damage. The hinged cabinet top is covered with a rubber mat. A spotlight with 20-foot cord plugs into the cigar lighter for night work. The Jeepster top can be raised in case of bad weather.

Sponge-Rubber Padding Protects All Passengers

BRYSON E. HICKMAN hopes he'll never crack up his home-built convertible. But he's well prepared. Sponge-rubber crash padding is fitted to the dash, seats, and doors. Even the rugs are padded.

Using standard parts, Hickman assembled the car himself at La Canada, Calif. Built on a Lincoln chassis, the car has a 135-hp. V-12 engine, overdrive, and a detachable convertible top. Doors, windows, trunk, and hood are operated through a hydraulic-electric system from a dashboard control.



The Laws No Car Can Violate

These simple home experiments will show you why.

By Kenneth M. Swezey

SIR Isaac Newton's First and Second Laws of Motion, set down nearly three centuries ago, are far different from the laws on the local statute books. *You can't*

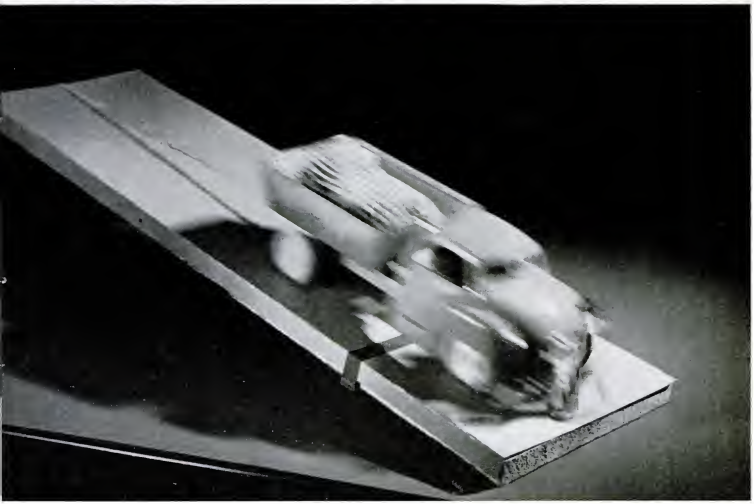
You can observe Newton's laws at work with this simple setup. Attach a toy car to the top of an incline by linked rubber bands so that its front bumper normally just reaches a line marked on the slope—the spot at which the driver supposedly applies the brakes. Now pull the car back halfway up the incline, as shown at left, and let it go. At such slow speed, car barely overshoots its mark (below).

break them even if you try. But they can easily break you, causing property damage, personal injury, or even death.

According to these laws, every body remains at rest, or continues to move at constant speed in a straight line, unless acted upon by an outside force. The amount of force required to change the motion of a body depends upon two things: the mass of the body, and the rate at which you must slow it, speed it up, or change its direction.

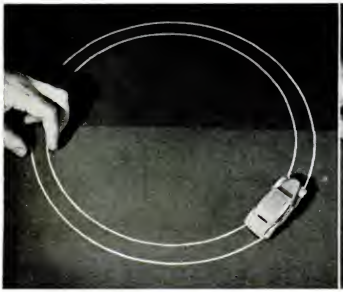
Applied to your car, these scientific axioms explain why you can't stop short at high speed; why you must reduce speed to keep from skidding or turning over on a sharp curve; and why it takes more power to start your car, or to accelerate it, than to keep it moving at a constant speed. The simple experiments shown here and on the next page may help you remember.

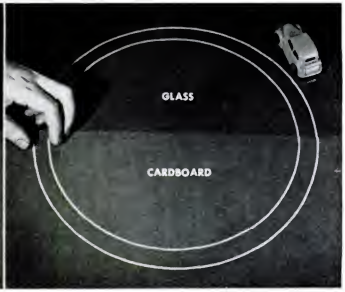
If you double your speed, the laws say, your stopping distance in a car will not merely be doubled—it will be *four times as great.* To demonstrate this rule dramatically, pull the toy car to the *top* of the incline, as at the left, and let it go. This time the car is rolling so fast when it reaches the braking line that it plunges right ahead and crashes headlong into the man in front of it (below).



More power is required to start your car than to keep it going chiefly because of *inertia.* This can be defined as the inherent sluggishness of matter that causes it to resist any change in its motion. You can test this law on the living-room floor by pulling a loaded toy car with linked rubber bands. The bands stretch considerably while the car is starting, left above; but they contract a lot when their only work is to keep the car rolling at a steady speed, right above.

Cars skid or turn over when rounding curves because their speed is too great for the sharpness of the curve. Both speed and sharpness determine the force that tries to throw them off the road. You can show this with the experiments above. A marble rolled down a cardboard trough into a large pie tin (left) follows the curve. Rolled from same distance onto a small tin (center), marble jumps off. Rolled from halfway (right), it stays on the track.





On unbanked curves, cars can keep to the curve only because of friction between the tires and road. Reduce this friction with dampness or ice, and cars may skid even at comparatively slow speeds. You can show this by running a spring-powered toy around a track that is half cardboard and half glass (to represent ice). On the cardboard, the car follows the curve exactly. But as soon as it hits the glass, at right, it swerves sharply off the track.

Down it goes. Ed Aspden's homemade rig makes short work of setting a 1,400-lb. septic tank in ground. Using a chain hoist, he lifts tank from truck bed, rolls it along monorail, and lowers it into hole. Telescoping legs brace end of monorail during loading and unloading.

Jeep Rig Lifts Heavy Tanks

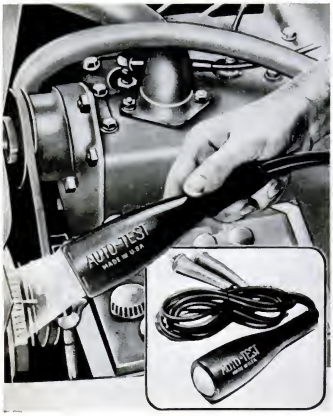
LIFTING, hauling, and setting a 1,400-lb. concrete septic tank usually requires several men. But Ed Aspden, of Erie, Pa., has made it a one-man—and a Jeep—job.

He does it with a ¾-ton Jeep pickup and a special lifting rig he welded together. The main components are a monorail 10 feet long, a four-wheel dolly that travels the monorail, and a chain hoist for the lifting.

The monorail projects four feet beyond the end of the channel-iron framework. During loading and unloading, telescoping pipe legs support the monorail end. Hooks on the top ends of these legs fit into loops welded on the monorail. The rig cost about $100, took 25 hours to build. END

Loading is simply the unloading procedure in reverse, again a one-man job. Corner uprights of the rig are 1" by 2" channel iron about 7' long. I beams to join the uprights were made by welding 1" by 2" channel iron back to back. Structure is reinforced by ⅜" diagonal rods.

Up in a tree is where Aspden keeps the rig between jobs. Hooking the hoist over a limb, he drags the entire business up out of the way. Note that 1" angle iron ties the cab-end uprights together. All of the corner posts fit into the stake pockets of the truck body.

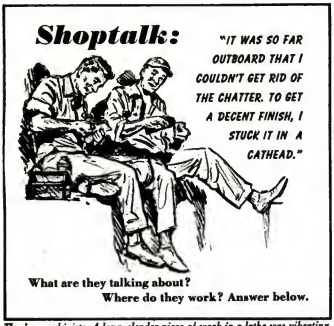


Rubber Protects Timing Light

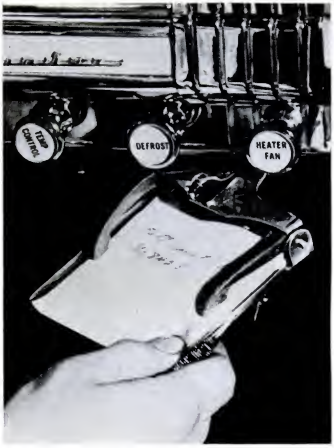
This low-cost ignition-timing light is cushioned in rubber. Its extra-long handle makes it easy to hold the light close to the timing marks. The neon tube is set in a white reflector. Made by Auto-Test, Inc., of Chicago, Neo-Flash® sells for about $6.

Soap Eases Tight Car Window

If a window in your car begins to work hard, it sometimes can be loosened up by rubbing a little laundry soap along the edges of the glass and in the channel.



They're machinists. A long, slender piece of work in a lathe was vibrating badly. A cathead is a sleeve that runs in a steady-rest. It steadies the work when it's being turned.

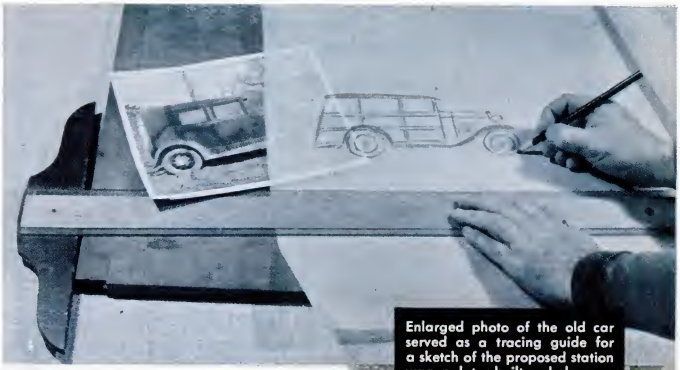


Miniature Desk for Auto

This miniature metal writing desk, for jotting down notes in your car, is easily attached to the dashboard by a single bolt. Complete with pad and pencil, the accessory can be adjusted to any angle for writing and swung back out of the way when not in use. The Auto Desk® is made by the Marsh Mfg. Co., of Santa Monica, Calif.

Sponge Connects to Hose

When connected to your garden hose, this sponge will scrub away the grit and dirt on your car without hurting its finish, according to the maker, Abar Plastics Co., of Pittsburgh, Pa. Set into a plastic holder, the Hand-ee-Sponge® can be gripped without squeezing out the water. It is also useful for household cleaning tasks.



Enlarged photo of the old car served as a tracing guide for a sketch of the proposed station wagon, later built as below.

How to Build a Station Wagon

By George Daniels

A NEW station wagon from the showroom floor was too much of a luxury for my pocketbook. But I now have one—and the amount I spent converting my old bus, a Model-A Ford, to this style of body was only a trifle more than the price of a couple of new tires.

Given an old car in good running order, you can make a similar conversion. There are two ways you can do it—apply plywood panels over the old car body, or remove the body and build a new one from scratch.

If the car dates back to pre-streamline days, the first method is easier and cheaper. You use the old body as the inner framing, cutting out its back end. The flat body panels make it easy to install the plywood.

But if the car has lots of curves, it probably will be best to cut away the body just behind the windshield, leaving the posts in place. In a pinch, you could cut it away with just a pistol-grip keyhole hacksaw.

As the first step in either type of conversion, take a broadside photograph of the car. Line up the camera at right angles to the wheelbase at its middle point. Have the picture enlarged to 8 by 10 size.

Over this photo, trace the general outlines of your intended station-wagon body, using the roof, windshield, and window posts as guides if you are going to use the old body as an inner frame. In your sketch, extend the body at least as far back as the rear tips of the back fenders. If you wish, it can overhang another foot or so.

This sketch will enable you to visualize the appearance of the completed body. From it, you can also estimate the materials needed. Using a ruler on the sketch, measure the proposed body in units of wheel diameters. Then measure the wheel diameter on the car itself. A little figuring will give you the approximate measurements of the body you plan to build.

You are then ready to start to work. The photos on the next two pages show you how the new body can be built using the old body as the inner framework.

1 **Make patterns** of the body panels from fiberboard, using your sketch as a guide. After lining up the pattern sheet, mark it on the inside with a pencil for the fender cutout and for cutting to the lower edge of windows.

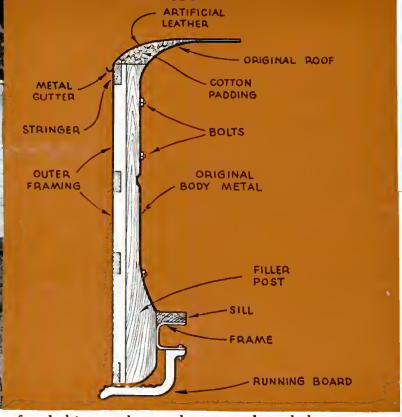
2 **Cut the pattern** along the waste side of the pencil lines. In addition to this pattern, you'll need another for the door. Patterns for one side are usually all you'll need; you can use them on other side with opposite face against car.

3 **Fit pattern snugly,** using a rasp to trim it as needed. Swing back or remove bumper for this. Cut filler-block frames to conform to body contours and fill space between pattern and body. Tack these temporarily to pattern.

4 **Trace pattern** on ¼" waterproof plywood after you have a good fit. Cut on the lines. Try the panel on both sides of car. If the body has been badly sprung, it may be necessary to make patterns for both sides.

5 **Cap top edges** of panels with wood sills, covering space between metal and panels. Mastic in the joints will lessen squeaks. Attach panels with ¼" rustproof bolts.

6 **Try door clearance** after attaching framing temporarily. After trim fits perfectly, secure it with waterproof glue and screws. You now begin to see how your station wagon will look.

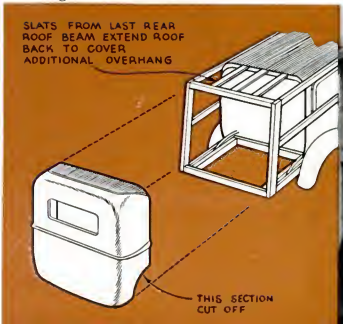


7 Cut the inside panel frames to follow the contours of original body. Remove handle from door for greater ease in fitting door panel. In stage shown above, rear panel is assembled but has not yet been attached permanently. Before bolting on the panels remove the upholstery from the inside of car. In drilling for bolts, be careful to locate them so as not to interfere with door or window mechanisms. The drawing above shows how the roof is finished off.

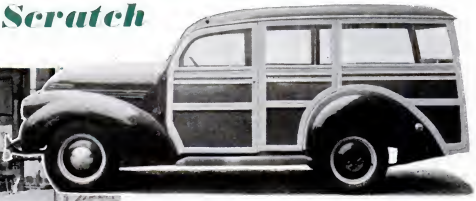
8 Leave top longitudinal of rear panel overlength to serve as guide in fitting the door panel. Clamp the latter in place to try it. Allow at least ½" clearance over the running boards so snow or ice won't jam the doors.

9 Curved framing over the fender can be laminated with waterproof glue, as this one was. You could also steam-bend it, or glue it up in sections. You will probably want to refinish the fenders and hood on car.

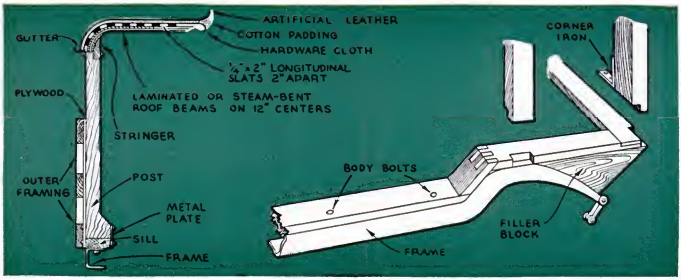
10 Cut away the rear of body and extend roof to suit new body overhang. If the station wagon is to be just a workhorse, you can install a simple half-height tailboard like the one at right below. You must also extend the floor back from the rear seat. Place a two-by-four cross beam under its rear edge. You can either remove the rear seat or build a frame of pipe to support it. For details on a curved-body conversion, turn the page.



For a Slicker Job, Build the Body from Scratch



A showroom model. That's what the conversion above looks like. A new body was built after the old one had been almost entirely cut away, left. Note that a new floor has already been installed. For this type of conversion, remove fenders and remount them on new body. Rear bumper can be either removed or relocated.



Construction details are suggested here. Dimensions should be adjusted to suit the particular car. If the original front doors hinge at front, you can mount new ones on the same hinges. In any case you can probably use the old hinges, door catches, and window mechanisms. For uprights, glue up hardwood to at least 3" by 3". Assemble with bolts and glue.

Fit all joints nicely and strengthen them with metal angles where possible. For a professional-looking job, use two hinged panels at the rear as above. Three coats of outdoor varnish followed by wax will give the body a fine finish. If heavy loads are to be carried, install overload springs. And one final point: notify your state license bureau of the model change.

Popular Science Practical Solution

Rack Holds Popular Science Open As You Work

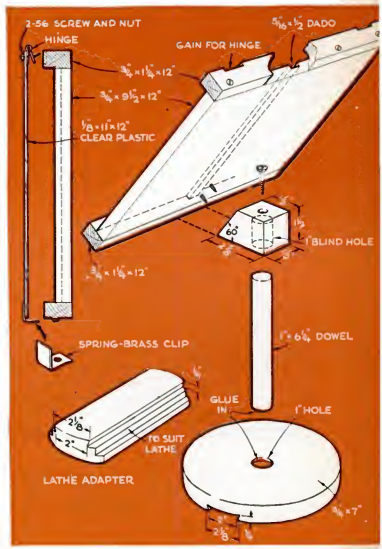
"THERE ought to be some way," pondered the Editor, "to have your favorite mag handy when and where you need it most—in the shop—without getting it dirty. How about a rack that will hold it open at the page you want?"

From this and a sketch was born the versatile holder shown here. Not only does it hold the magazine open and *flat*, but with an adapter plate it slides onto the ways of a lathe, where you often want to refer to a drawing repeatedly.

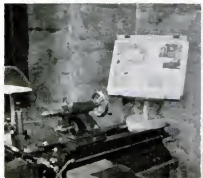
Saw the disk for the base from a piece of ¾" stock, but rip out the dovetail first, while it's still in the square. Use a 1" Forstner® bit, if you have one, to bore the blind holes for the dowel standard in base and block.

The rack proper consists of a 9½" by 12" piece with a center dado in which the spine of the magazine lies. Cleats are screwed on at top and bottom, the upper one having gains for small hinges. An 11" by 12" piece of ⅛" plastic is attached with tiny (2-56 or 3-48) flathead bolts and nuts, the latter on the outside. Two wood screws driven in beneath the bottom cleat engage holes in spring-brass clips fastened to the lower edge of the plastic. Attach a knob, such as a toothpaste-tube cap, between the clips.

Two wood screws running right through the dado fasten the rack to the pivoting block, which is cut at 60° to provide a convenient reading angle. It should pivot freely on the dowel. END

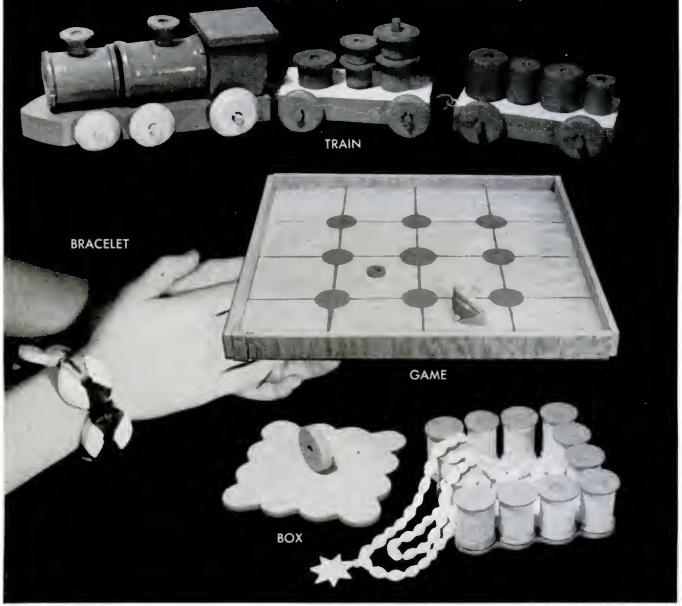


Information at your elbow. You could skip the dovetail by bolting the adapter to the base.



Use Your Old Spools

DON'T throw away those old spools. They have lots of uses as toys, games, or decorative pieces. For the small fry, an interesting game can be made from a board and a spool. Paint the board as shown. Whittle a spool to make a top. Cut a slice from a spool barrel and start the top spinning in this slice. If the top lands in a square, score 5; in a circle, 10; on a line, 0.—*Elma Waltner, Hurley, S. D.*



Resistor Acts as TV Antenna

NOT being satisfied with the results of my indoor television antenna, I tried a novel substitute. I removed the antenna and attached a 250,000-ohm resistor across the two input terminals. Then I hooked one foot of stranded wire to one of the terminals and thumbtacked the other end to the wall behind the set. The results were surprising and excellent. Pictures are actually sharper than those obtained with an indoor antenna. In different locations I have had to change the length of the wire, starting with a long piece and cutting it off inch by inch.—*Tony Vrlec, Chicago.*

Punched Can Rim Saves Paint

WHEN you open a new can of paint, punch a few slots in the rim around the top of the can with an old screwdriver. Surplus paint scraped off the brush will then drain back into the can. It will also be easier to replace the cover without splashing paint trapped in the rim.—*Harold R. Terpeny, Marion, Mass.*

Magnet Holds Auto Tray

HERE'S a utility tray you can set at any convenient spot on your dashboard shelf. A flock-covered magnet on the bottom makes it stay put without screws or suction cups. Polyscope Equipment & Appliance Co., of Brooklyn, N. Y., prices it at about $1.

Oil Drums Protect Packages

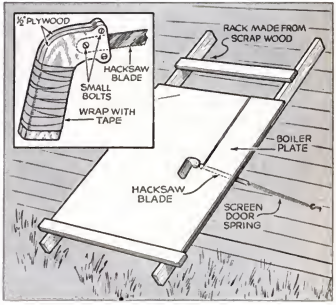
INEXPENSIVE but serviceable package boxes can be made by cutting a rectangular hole in a steel drum and attaching a sheet-iron door. A hasp is used to keep the door closed. Holes in back take bolts that secure the drum to a post so that wind and livestock will not upset it.

Plastic Belt Fuses Together

PLASTIC belting now on the market can be made into an endless belt by touching together and heating the two ends. Developed in Switzerland, the belting is widely used there to drive watchmaking machinery. It's distributed here by Jules Borel & Company, of Kansas City., Mo. The belting, called Fuse-ite®, is made in flat, V-belt, and round form.

Flashlight Has First-Aid Kit

Two important emergency aids for your home or car—a first-aid kit and a flashlight—are marketed in one compact package for about $1 by Lewyt Corp., Brooklyn, N. Y. Its size, 1½" by 3" by 6", makes it easy to slip it into the glove compartment.



Spring-Pull Saw Cuts Metal

BECAUSE I don't own a torch, I had to figure out another way of cutting a sheet of boiler plate. Here it is. Holding down the plate with my left hand, I pull the hacksaw blade with the other. The spring pulls the blade back, providing the cutting power. It's slower than a torch but gets the job done without need of later smoothing. —*W. M. McKeever, Darwin, Calif.*

Two levels in this window box are designed to show off both long- and short-stemmed flowers.

After the segments of the outer box are cut to shape and the ends grooved for splines, the pieces are checked for correct joint fit.

The back of each joint in the outer box is reinforced with a gusset. Splined joints are assembled with waterproof glue and clamps.

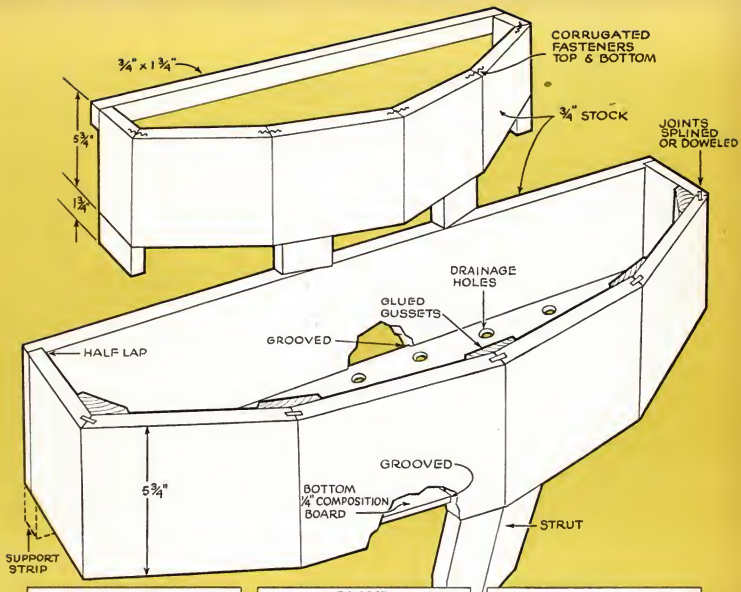
Bottom made of waterproof composition board is slipped into grooved front assembly. Back is then attached with nails and waterproof glue. Note small drain holes drilled in bottom.

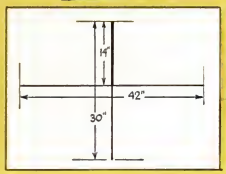
Flower Bed with Terrace Fits Window

By Roland Cueva

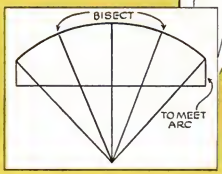
WITH Spring taking over this month, now's the time to build window boxes. The box shown above has two sections and was built with redwood, which is light and resists rotting. The three small drawings on the opposite page show you how this box was laid out to fit under a typical window. If you want it larger or smaller, alter the dimensions in proportion. Make a full-scale drawing on a large piece of wrapping paper and let your lines represent the outside edges of the ¾″ stock.

With the drawing as a guide, cut the segments of each box. Then stand them on edge on the drawing to check joint fit and length. Next, groove the outer box segments for 3/16″ splines. Cut grooves ¼″ by ¼″ in all segments of the outer box to take the

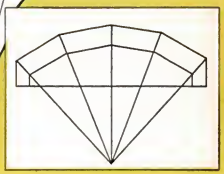




1. Lay out full-scale pattern on a large piece of paper. As the first step, draw the two lines to the dimensions shown.



2. Swing an arc from bottom of 30″ line. Draw end lines to meet arc. Bisect arc twice and draw radius lines as shown.



3. Connect points on arc with straight lines. Draw in 3″ lines at ends. Lines forming inner box parallel outer ones.

bottom. Make the bottom of ¼″ waterproof composition board. Drill drainage holes in it.

After the bottom is in place, the back is fastened with glue and nails. A ¾″ by 2″ batten, screwed along the centerline on the bottom, completes the outer box. The supporting strut is attached to the batten with a strap hinge.

The inner box has no bottom or solid back. It simply rests in the larger box. Paint the unit inside and out and it's ready to mount.

END

Back of outer box is screwed to side of house; strut supports front of box. Inner unit, raised by its block feet, sits inside larger box.

Make Your Own Geiger Counter *According to AEC Specifications*

This instrument was built by a PS editor in one evening. It's the type that Atomic Energy Commission experts recommend for science students and home workshoppers.

New circuits and parts make it easy and inexpensive to build a good radiation detector or survey meter.

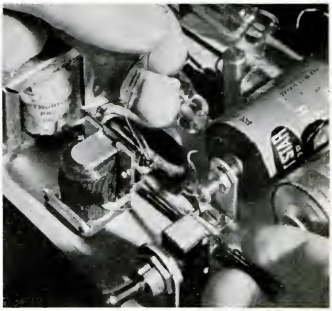
By Robert Gorman and Hubert Luckett

NEW circuit designs for Geiger counters, worked out by the Atomic Energy Commission, now make it possible for experimenters to build good instruments for measuring radioactivity. These counters are excellent for school or home laboratories or as survey meters for uranium prospecting.

The model shown here, built by POPULAR SCIENCE in cooperation with the AEC, is the simplest of several types of counters based on the new circuitry. (Others are shown on the next page.) You can duplicate this model on your kitchen table for about $25.

This cheap and easy-to-build counter was a by-product of efforts to produce better instruments than those now in use. It will clearly detect radiation from the radium-painted dial of a clock or watch, a dentist's X-ray machine, or pre-war bathroom tile that was colored with uranium.

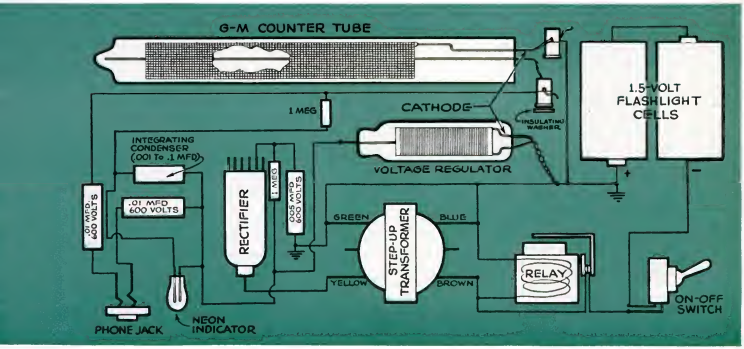
What a Geiger counter does: The heart of a Geiger counter is a gas-filled tube containing a cylindrical cathode and a fine-wire anode. A voltage is applied across these electrodes, but no current flows between them because the gas acts as an insulator. When a radioactive particle strikes the tube, however, it sets off an avalanche of ionization, and makes the tube momentarily conductive.

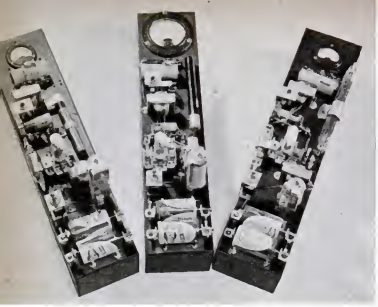


Adjust the relay points for about 30 contacts a second. Connect a 1/25-watt neon bulb across the relay coil and adjust contacts or spring until bulb is just below point of steady glow.

To use such a tube, you need a high-voltage source to make the tube sensitive to radiation. Then you need a metering device to count the pulses of current that flow when it's ionized. Counting can be by earphone clicks, neon flashes, or meter deflection.

In the POPULAR SCIENCE model this associated equipment is simpler than in other counters of comparable quality. One of the developments that made this possible is an ingenious power supply that furnishes all the necessary voltage from *two flashlight cells.* Another is a newly developed counter tube that operates at relatively low voltage (about 350 volts as compared to the 900 to 1,200 volts of earlier tubes). This





Laboratory models built by AEC use metering circuits and 900-volt counter tubes. Basic design is the same as PS model, but components and adjustments are more critical. A 10-cent pamphlet with more information is sold by Document Sales Agency, AEC, Oak Ridge, Tenn.

Here's a complete setup including mica-window tube (clipped in) and interchangeable gamma tube. The bottle contains a Bureau of Standards radium solution. Crystal headphones have to be used for high counts. The glass ring is uranium-dyed, makes the counter tick.

tube contains new inorganic gas mixtures that make it 10 to 20 times as sensitive as its predecessors. A much larger charge per pulse is obtained. So, when this tube is used, elaborate amplifying and metering devices can be eliminated and the output of the tube can be seen and heard by means of a neon flasher and crystal headphones.

Power supply: A standard normally-closed relay is used as a current interrupter. It pulses the current from the batteries and feeds it into the primary of a transformer in short, sharp bursts. This produces an inductive-kickback effect and gives a tremendous voltage boost in the secondary. The three-volt source and a 10-to-1 transformer can put out as much as 1,600 volts.

Current drain from the battery is amazingly small—in the neighborhood of 30 milliamperes. One model was left running continuously for eight days and nights without using up the original pair of flashlight cells.

The high-voltage AC is changed back to DC by the rectifier tube, which is the cold-cathode type requiring no stand-by power. For stable operation, the voltage is filtered and then passed through a regulator tube.

Counter circuit: When a 1/25-watt neon bulb is wired in series with one of the tube's terminals, the electric charge resulting from ionization causes the lamp to flash. Though multiplied many times in the tube, the charge isn't great enough to give a bright light, so an integrating condenser must be placed across the neon lamp. This gives a brighter flash at longer intervals—making it easier to count individual pulses. The value of this condenser may be varied from .001 to .1 mfd. The higher the value, the brighter and more widely spaced the flashes will be.

The neon flasher isn't satisfactory under all conditions. It can't be seen too well out of doors, and a highly active source will just cause it to glow. An auxiliary jack is therefore provided for use with *high-impedance crystal* headphones. Note that the ordinary magnetic type won't do.

Construction: Actual building is simple and straightforward. The POPULAR SCIENCE model is shown spread out on a breadboard. It could equally well be compacted on or

LIST OF PARTS

G-M Counter tube: Type EP 30 G (gamma tube) or EP 30 M (mica-window, beta and gamma.)
Voltage Regulator. Type EP 30 RS. (All of above made by Electronic Products Co., Mt. Vernon, N. Y.)
Rectifier: Type CK 1013, Raytheon Mfg. Corp., Newton, Mass.
Relay: SPST, normally closed. The following types have been used successfully:
Advance Relay Co., Los Angeles: Type 5002 or 104 AM–2A, both 15-volt AC coils.
Allied Control Co., New York: Type BG, coil 34, 133 ohms. Type F, coil 32, 47.5 ohms. Type LK, coil 32A, 68 ohms.
C. P. Clare & Co., Chicago: Type C or G, 50-ohm coils.
Step-up transformer: Type 20A00, Thordarson Electric Mfg. Co., Chicago.
Neon lamp: 1/25-watt, any type.
Condensers (all 600 volts):
two .01 mfd.
one .005 mfd.
one .001 to .1 mfd. (see text).
Resistors: two 1-megohm, 1-watt.
Switch: SPST toggle.
Flashlight cells, insulated grid cap (for rectifier-tube connection), phone jack and crystal headphone, neon-lamp holder, binding posts, misc. hardware.

inside of a radio chassis. To convert the breadboard model into a portable survey meter, it is only necessary to fit a wooden cover over the board.

The clips that hold the batteries and tubes are ordinary broom holders. There's nothing critical about the wiring or placement of the parts, and shock hazard is so low that no special precautions are needed.

Adjusting the power supply: To get the relay to work properly, it may be necessary to adjust the contact points or spring tension slightly. Contacts should make-and-break about 30 times a second, producing a sound that falls just between a tapping and a steady, low-pitched buzz.

It's nearly impossible for a home workshopper to tell exactly what voltage his power supply is putting out, for an ordinary vacuum-tube voltmeter loads the circuit too much to give an accurate reading.

However, for the POPULAR SCIENCE counter it isn't necessary to know your voltage exactly. The relatively low voltage required by the counter and regulator tubes makes it practically certain that you'll be getting all you need. But you can make a couple of quick checks.

When the wiring is completed, connect a neon lamp across the relay coil (the indicator lamp can be used). With the relay vibrating, the lamp should flash—just between a flicker and a steady glow. Try bending the points until the light is just under maximum brightness.

In a darkened room you should also be able to see a dim glow through the top of the rectifier tube. If you can't, the polarity may have been switched somewhere along the line. Color coding of the transformer leads is not uniform in all cases. The remedy is to switch the batteries, putting the shell at ground instead of the positive terminal as in the diagram.

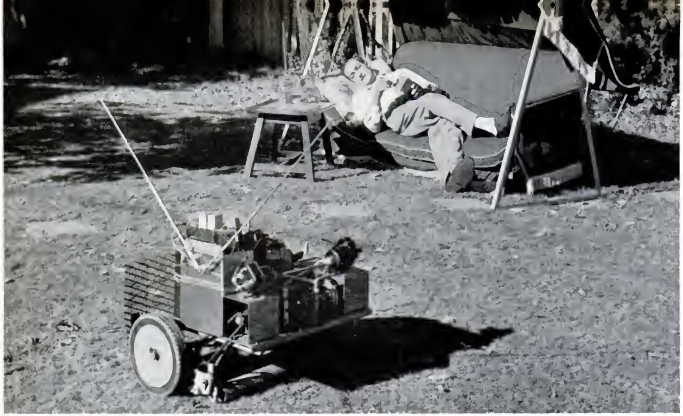
What parts to use: The components of the AEC Geiger counter are critical and are therefore specified in detail in the parts list. Most of them are available from radio supply houses. If you have trouble, write to POPULAR SCIENCE for a list of suppliers.

How to read your G-M counter: Exact calibration of a Geiger counter is very difficult, but fortunately you don't have to put this instrument on an absolute scale in order to get useful readings.

You can buy radioactive samples from scientific supply houses and from the National Bureau of Standards. The standards sold by the NBS range in price from about $3 to $10. By counting the flashes produced by a known sample held at various distances from the counter tube, you can estimate the relative radioactive energy of any unknown sample. Information on available standards can be obtained from Dr. L. F. Curtiss, National Bureau of Standards, Washington, D. C.

The work of developing this counter was done under the direction of Harris D. Le Vine, chief of the Instruments Branch, and Hugo DiGiovanni, chief of the Electronics Section, New York Operations, AEC. END

For precision work it is important to minimize stray background radiation. A lead block with a hole bored through the center forms a perfect shield for the mica-window tube. The block is raised on plastic spacers to permit sample trays to slide directly under tube window.



Mows Lawn by Radio—Pretty Soft!

While his robot lawn mower chugs around the lawn, Jim Walker, of Portland, Ore., takes it easy in his glider, sipping a cool drink and operating the radio controls.

Walker, a radio ham, long-time builder of radio-controlled model planes, and president of a model-airplane company, developed the robot mower after ninety days of tinkering. He plans to build and sell similar rigs for license-free frequencies.

The mower is a standard job, driven by a one-cylinder gas engine. Separate clutches operated by solenoids control the power to each driving wheel. Normally the mower runs straight ahead, but either wheel may be declutched by radio to steer the robot or turn it around. If you punch one button, it pivots around the disconnected wheel; if you punch both, the mower stops. The engine and cutting reel run at a constant speed. A main clutch is adjusted to slip if the mower jams on an obstruction, and a triggering bar in front shorts out the spark plug if the mower bumps anything.

The radio consists of two small transmitters and receivers, although a single-channel rig with audio discrimination may be used. The transmitters are simple one-tube affairs, powered by hearing-aid and flashlight batteries. Walker says he gets accurate control over a quarter of a mile away.

Outboard Runs Model Boats

It looks like a real outboard motor but it fits in the palm of your hand. Hook it up to flashlight batteries—three to nine volts—and it races a model boat over a circular or straight course. At six volts it turns up 1,850 r.p.m. It has a bright silver finish and is sold for about $4 by International Models, Inc., of New York City.

Cigarette Pack Is Reminder

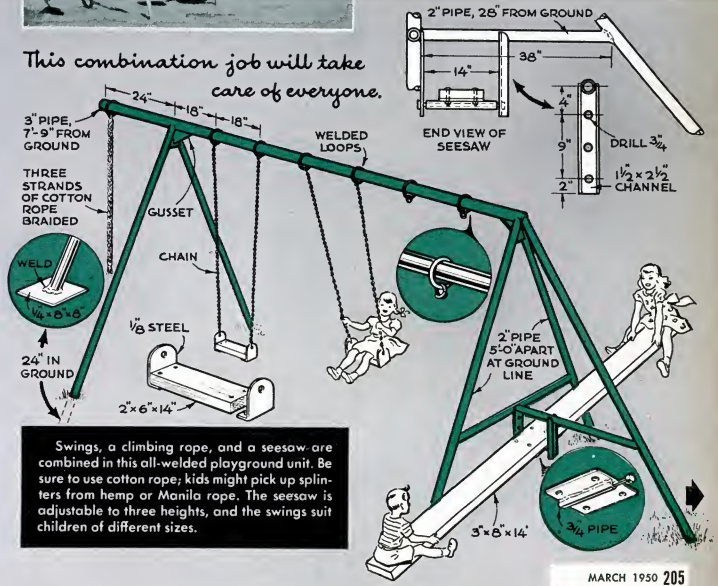
Slip a note between the cellophane wrapping and your cigarette package. It'll serve as an on-the-spot reminder of engagements and errands.—*M/Sgt. John M. Overstreet, Birkenfeld, Germany.*

With summer just around the corner, now is the time to build play equipment. Here are six pages of suggestions, from slides to swings.

Make Your Yard a Playground This Spring

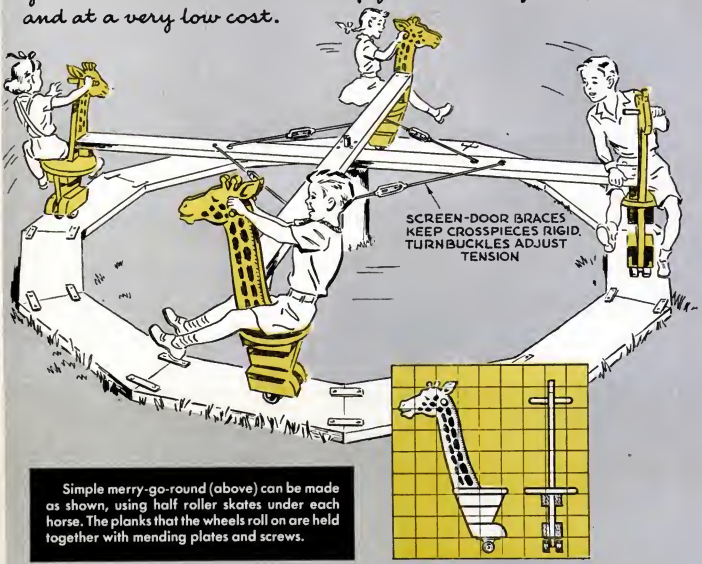
EVEN if the area you have for play space is limited, you probably can fit in some of the equipment pictured on these pages. All the pieces are sturdily built. On the heavier units made of pipe—such as the swing and seesaw assembly—you can use either threaded or welded joints. The feet are anchored underground with steel plates.

This combination job will take care of everyone.



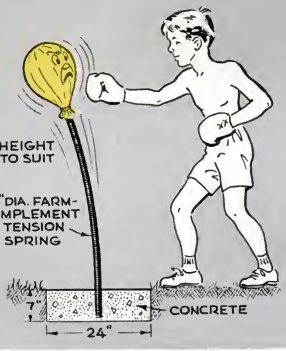
Swings, a climbing rope, and a seesaw are combined in this all-welded playground unit. Be sure to use cotton rope; kids might pick up splinters from hemp or Manila rope. The seesaw is adjustable to three heights, and the swings suit children of different sizes.

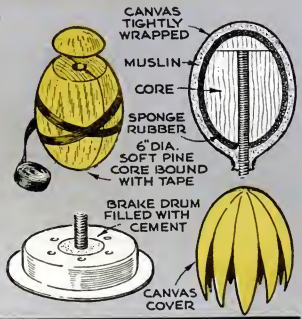
You can build this novel merry-go-round in your spare time and at a very low cost.



Simple merry-go-round (above) can be made as shown, using half roller skates under each horse. The planks that the wheels roll on are held together with mending plates and screws.

Does your boy need something to hit? Build him this sturdy punching bag.





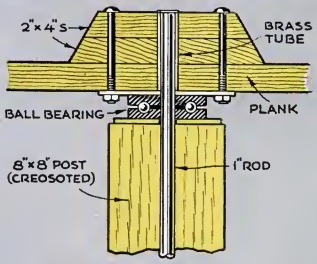
Boys get a bang out of this punching bag. You can buy the spring from a farm-implement dealer. Core of soft pine is made in two halves with a wooden cap screwed on. Canvas cover is made of canoe-shaped pieces stitched together.

Here's another variation of that old playground favorite. Start building it now!

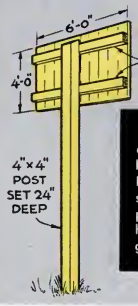
20'-0"
18"
14"
36"
30"
18"
10"
3/4" WOOD
ANGLE STOCK WELDED AT RIGHT ANGLES AND SET IN CONCRETE
OIL
OIL-SOAKED COTTON
BRONZE BUSHING
PIN
WELDED
1" STEEL ROD
24"
1 1/2" PIPE
BRONZE BUSHING
PIN
2"×8" PLANK
STEEL DISKS
BALL THRUST BEARING
IRON COLLAR WELDED TO PIPE AND ROD. ONE AT BOTTOM ALSO
2 1/2" PIPE

Here are a couple of sturdy center mountings for merry-go-rounds. One above with the ball thrust bearing is self-oiling, will stand up under lots of rough wear. Below is simpler type, oiled at the top of the brass tube. To make a four-passenger merry-go-round, just add another plank and strap-iron braces.

A basketball backboard is a must for every sport-minded boy or girl.

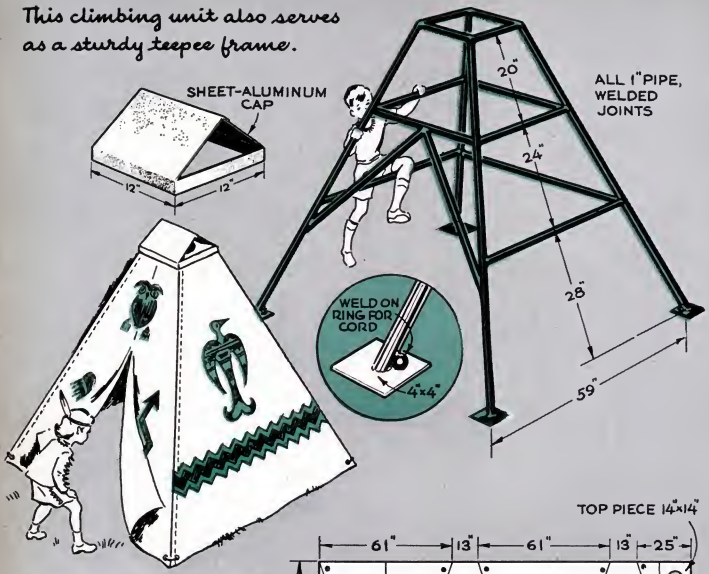


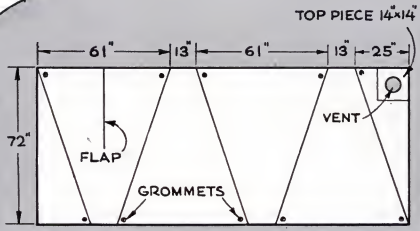
ALTERNATIVE PIVOT



A four-by-four and a few boards make this basketball backboard. Part of post in ground should be creosoted to prevent rot. Official height of basket from ground is 10'.

This climbing unit also serves as a sturdy teepee frame.



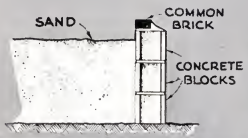


Kids have double fun with this one—as either climbing bars or a tent. Five yards of canvas 72" wide make the tent (right), allowing 1" lap at the seams. Galvanized pipe is used for the framework.

A swing cut from an old truck tire is a lot of fun for kids of all ages.

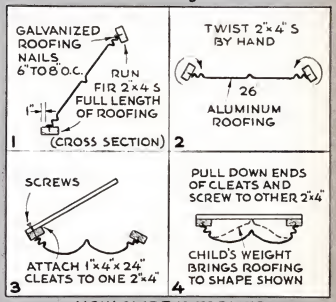
Here's a quickie swing. Cut away all parts of an old truck tire except beads and part of tread to form a seat at the bottom.

Don't forget a sandbox. This one won't fall apart.

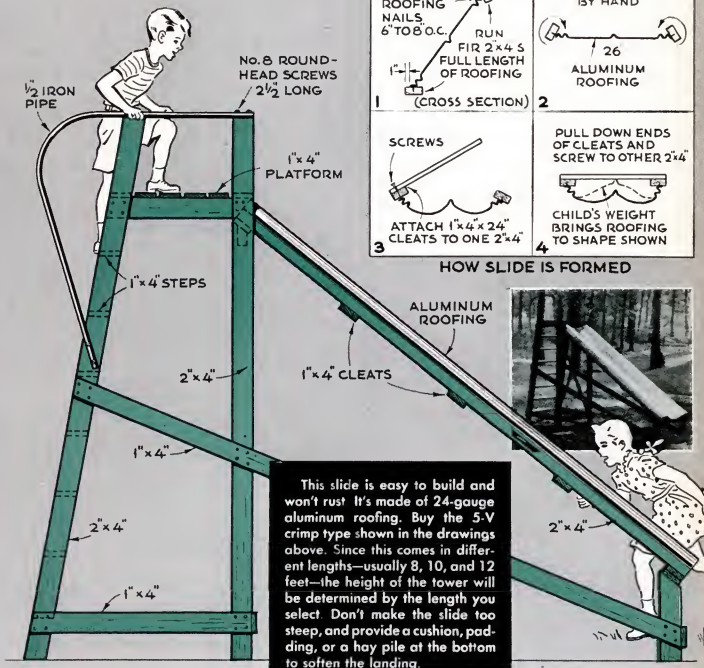


Build sandbox to suit your space. Make it deep enough so children aren't likely to dig down through sand to earth. Walls are concrete blocks topped with red bricks.

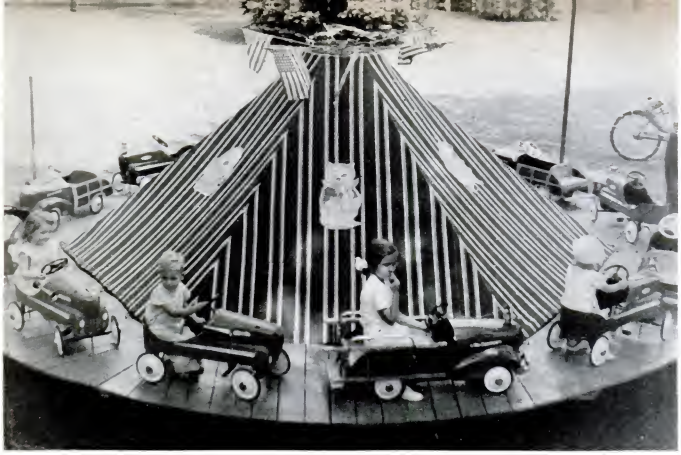
Aluminum roofing and a few simple tools will give your child a slide that will be the envy of the neighborhood.



HOW SLIDE IS FORMED



This slide is easy to build and won't rust. It's made of 24-gauge aluminum roofing. Buy the 5-V crimp type shown in the drawings above. Since this comes in different lengths—usually 8, 10, and 12 feet—the height of the tower will be determined by the length you select. Don't make the slide too steep, and provide a cushion, padding, or a hay pile at the bottom to soften the landing.



Cars are bolted to wooden platform that rotates. Canvas centerpiece covers the mechanism.

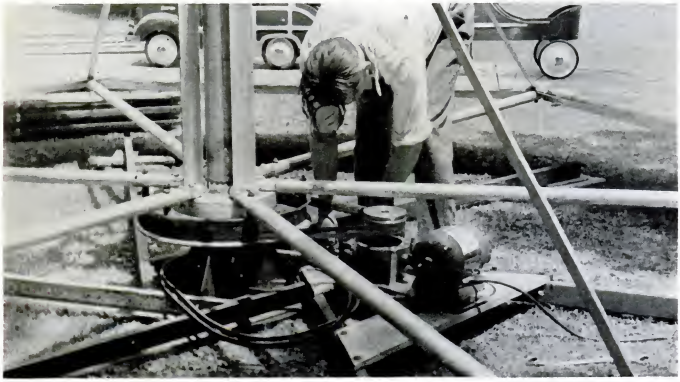
Here's a merry-go-round a Kiwanis Club built for the children of Columbus, Wis.

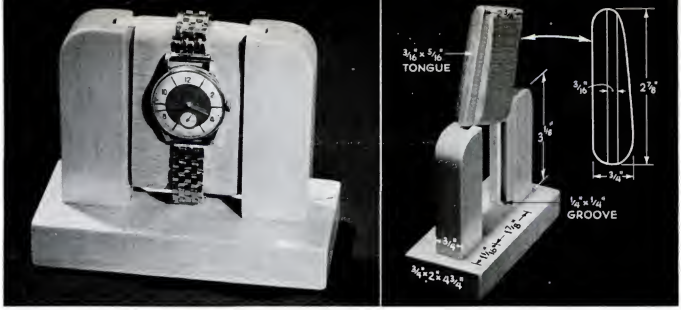
WHEN neighborhoods or communities pool their skills, you get a lot more done than if one man tried it. Here's an example of a community project.

In Columbus, Wis., the kids needed play equipment in the town's park. The Kiwanis Club came up with the answer for less than $200 plus the combined skills of the membership. One member machined the parts. Others welded, drilled, and bolted the parts together.

The ride is built around a 4" pipe with a ball bearing at the bottom. An old auto tire rim is welded to the center section. V belts connect the rim to a speed reducer and the ½-hp. motor that drives the ride. END

Two spare drive belts are in place so ride will not have to be taken apart if the belt breaks.

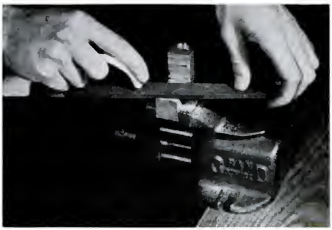




Stand Holds Wrist Watch Upright

THERE are many times when you want your wrist watch to serve as a stationary timepiece, placed where it can easily be seen. This hardwood stand holds the dial upright so it can be read comfortably, and is fine for a bedside table or desk.

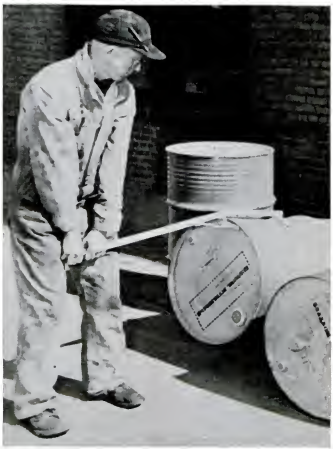
The stand consists of two grooved posts glued and doweled to a base. Matching tongues in the slide block fit the grooves snugly. All stock for the unit is ¾" thick. Dimensions may be changed to suit materials.—*George N. Jones, San Diego, Calif.*



Handle Improves File Grip

BETTER file control is provided by an interchangeable handle that fits most files. The Handee-Guide® handle moves the grip forward above the file, permitting work to be done with a level, planing motion.

The shank of the file fits a tapered notch in the handle. It can be wedged in or released by a single tap. The sides of the notch are hardened to resist wear. The handle can be used with flat or half-round files and fits all lengths from 8" to 16". It's made by the Riverview Foundry Co., Fall River, Mass., and sells for 49 cents.



Tool Speeds Drum Handling

THIS tool for upending barrels and drums uses expanding strap-iron saddles at the points of leverage and lifting. Both saddles spread out as lifting force is applied. This feature insures a positive grip even on wet or greasy drums, according to the D. S. Campbell Company, of Cleveland, manufacturers of the E-Z Up®.

CRAFTSMAN AT WORK

Arthur Morgan is shown here finishing up one of his caricatures carved from basswood. He also works in walnut, mahogany, and birch. Though harder to carve, these finish beautifully with wax or clear varnish.

SOME years ago, Arthur R. Morgan, of Naugatuck, Conn., saw an article in POPULAR SCIENCE on carving a hobby horse from a block of wood. He set to work and ever since has been riding the hobby. His specialty is sculptured cartooning.

The figures are carved from basswood and painted with artists' oil colors thinned enough to get good penetration without danger of the colors running together. Morgan prefers basswood because it is easy to carve, has a close grain, and takes colors well.

What fisherman hasn't entangled his line in something or other? Morgan saw this happen. Result: another carving.

This jolly Mexican and his burro were the result of attending a western movie. Morgan keeps on the lookout for likely subjects.

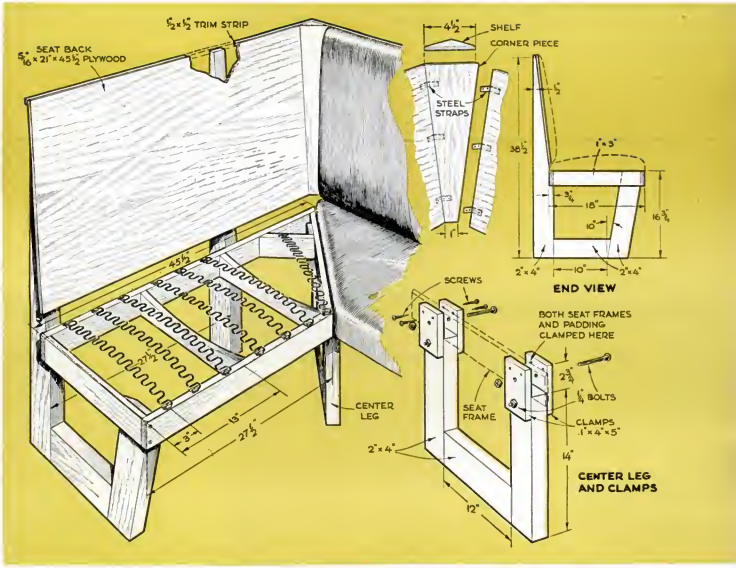
The Town Crier was dreamed up after Morgan visited a 200-year-old house and became intrigued with that period.

This one is called "The Skating Teacher." Any skating pond will offer ideas for caricatures. Here each figure was carved individually and then attached to the ice-pond base.

Completed unit, left, not only is comfortable but also dresses up corner. Benches are not fastened to wall. If you prefer, you can anchor them to the floor.

With a table in place, below, corner unit becomes breakfast nook. Although benches have both springs and padding, this is not a tough upholstering job.

Cozy Corner Costs Only $17



By W. Arthur Heacock

BESIDES adding to the appearance of a room, this attractive corner unit combines with a table to form a comfortable breakfast nook. The seats have both padding and springs—more than can be said for most breakfast-nook benches. You can build it with hand tools and the cost of materials comes within $17, including the plastic upholstery cloth.

The drawing on the opposite page gives you dimensions and construction details.

Assemble the frame of each seat with screws. The legs and backs go on after the upholstery. Mark the points where the springs are to be attached. You can buy sinuous springs of the kind shown below—as well as the clips that hold them—at an upholstery-supply house. The springs should be long enough to form a curve 1½" to 2½" high at the center when the wire is attached to the frame.

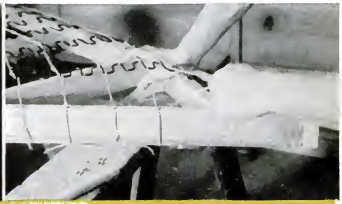
The next step is tying the springs. This is important. Broken ties let a spring move independently when the seat is used. Eventually, the moving spring will work its way through the upholstery. So don't be afraid of overdoing the tying department.

Run the ties 3" apart and at right angles to the springs. Start by knotting one end of the spring twine and stapling it to the frame. Use overhand knots to tie it to each spring. Keep the twine pulled tight. Finish by stapling the twine to the frame.

Cover the springs with canvas or burlap, drawing it tight and tacking it to the underside of the frame. Lay on two layers of sisal fiber and one layer of cotton batting. Then cover the padding with burlap or canvas. After the second canvas is tacked down under the frame, thread a large needle with twine and run it through the whole padded assembly at not less than 3" spacing. This keeps the padding from slipping.

After you've tacked the upholstery cloth in place, attach the legs and backs. You can butt the ends of the backs together, or you can insert a wedge. END

One screw at each end anchors clips for springs. The springs used should be long enough so they form curves 1½" to 2½" high at the centers.



To prevent springs moving from side to side and wearing through padding and upholstery, they must be tied with spring twine.

Burlap is laid over springs and tacked down under frame. Then come two layers of sisal fiber and one layer of cotton batting. This is covered by burlap tacked to frame. Plywood backs (middle photo below) are covered with two layers of sisal and one of cotton topped with burlap. Cardboard makes smooth ends. Tack through cardboard and material from inside material. Fold down and tack plastic upholstery fabric under frame. Use decorative tacks on corners.

Timesaving Tools for Woodworkers

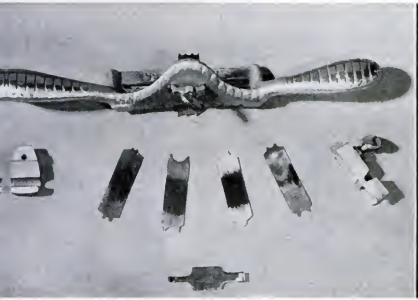
Corner-rounding tool comes in several sizes, should be used with the grain. It's good for rough work since it cuts faster than a plane. The tool can be sharpened with a fine file.

WHILE skill and basic tools will often turn the trick in woodworking, there are some comparatively uncommon tools that make difficult operations easier. Seven of them are shown here. Some, like the scratch stock, have been used for centuries; others, like the magnetic brad setter, are new. The doweling jig is especially useful, since boring accurate dowel holes is a tough job even for experienced workers.

Nail puller. Plunger sinks jaws enough to grasp nail head. Arm provides leverage to pull nail straight up, minimizing damage to wood. Small dents made by jaws can be filled.

With wood taps and dies for cutting threads, you can make adjustable stands, vises, cabinet clamps, and many special fixtures. Tool on bench is a tap for threading holes in wood.

Boring dowel joints—a common furniture-making operation—is difficult to do accurately without doweling jig. Only one adjoining face and edge need be marked. Holes are located with gauge on jig. Then drill guide is set, jig clamped to work, and holes drilled. If you're using dowels of smaller sizes, twist drills are preferred to wood bits since they are less likely to drift.



Scratch stock—pictured above with blades and straight and curved fences—is a simple tool for making straight or curved moldings. Blade is locked in stock and pulled along in direction of grain. Fence rides against edge of work and guides blade. Successive passes are usually required and it may be necessary to reset blade to make exceptionally deep cuts.

No need to pound your fingers if you use a brad setter. Magnetic plunger in a hollow cylinder picks up brad and holds it in tube. Pressure on handle pushes brad into the work.

Miter vise has two sets of jaws working at right angles to each other. Mitered pieces are held tightly for nailing or gluing. Doweled miter joints can be held in place while glue sets.

Lathe Cuts Worm Gears. Using a lathe to cut special worms is a fairly common operation. I've found that with the setup shown above it's easy to cut matching worm gears, too. I pin a blank on a turned post with a suitable indexing gear keyed on at the other end. The post is mounted with two nuts, so that it can just be turned, on a shank clamped in the tool post and twisted to the worm's helix angle.

I turn the gear blank with a concave throat of the same radius as the worm has at the bottom of its teeth. Multiplying the pitch (distance between teeth) by the number required, dividing by pi, and adding the tooth depth gives the diameter of the blank across the bottom of the throat.

A screw filed to a taper is mounted as an indexing pin on a piece of flat spring stock clamped in the tool-post slot. Then a boring bar is chucked to swing in a radius equal to that of the outside of the worm teeth. A crossfeed stop helps assure uniform tooth depth. After each tooth is cut, the post is indexed (right above).

For small and medium ratios, use double or triple-thread worms and correspondingly two or three times the ratio number of teeth on the gears.—*Elman Wood, Poulsbo, Wash.*

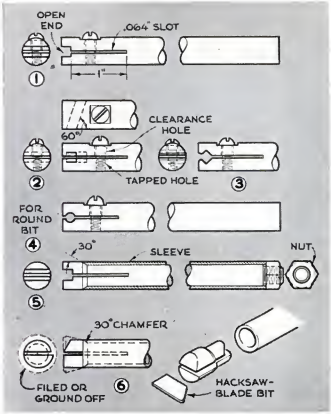
Drill Pad Fits Crotch Center. If you already have a crotch center, it will do double duty as a drill pad when fitted with a detachable cover.

Chuck a suitable piece of stock, face, and turn to diameter. Reverse in the chuck and machine a recess about 3/16″ deep to a light drive fit for the crotch center. Press this in, making sure it bottoms squarely.

Make two witness marks on both members for reassembly. Then push the crotch center into the live spindle and face off the pad with a very light skimming cut.

The pad may be detached by striking it with a brass or plastic-faced hammer.—*Joseph Tracy, Manhattan, N. Y.*

Dodges with Dividers. Besides their regular uses, dividers are handy for scribing a line parallel to an edge. Let one leg ride outside, against the edge, and scribe with the other. To find a centerline, scribe from both edges with trial settings until the scribed lines coincide.



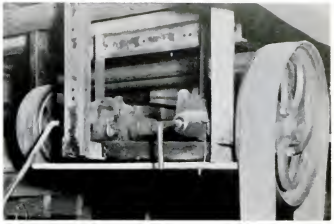
Small Boring Bars to Order. These six styles can be made up even in sizes under ½"—valuable for delicate instrument and model work. The business ends are slit to grip the bits.

The open-end bit sockets can be sawed and filed. Square bit holes (Figs. 2 and 3) can be drilled and then filed to shape. Bits for the bar in Fig. 4 are ground from old drills as small as 1/16"; the bar can be ¼".

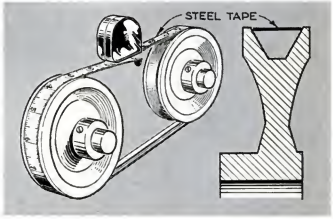
A collet action closes the bars in Figs. 5 and 6. As a nut on the far end draws the head into the sleeve, matching chamfers pinch the jaws on the bit. For the bar in Fig. 6, bits are ground from pieces of hacksaw blade. Saw the slot with a similar blade after grinding off all set. Bits shouldn't project more than their own thickness.—*M. Duhamel, St. Hyacinthe, Que.*

Jig Locates Center Holes. Useful for centerdrilling a variety of short-run jobs, this simple jig is adjustable and takes the place of several ordinary ones.

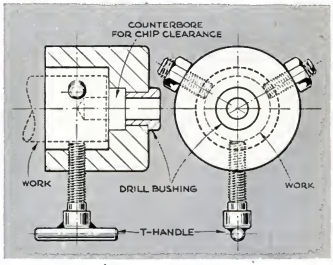
The body is a piece of round tool steel, bored out a trifle larger than the biggest work likely to be handled. Three radial holes are drilled and tapped 120° apart. Two of them are occupied by setscrews with lock nuts to retain adjustment, and the third hole is fitted with a T-handle screw for quick clamping. The end of the jig is drilled and reamed to take standard drill bushings.—*Roger Isetts, Kenosha, Wis.*



Drive Has Nine Speeds. An old dual transmission from a truck, belted as above to the motor driving a milling machine, gives the operator a quick selection of nine forward speeds without belt shifting. Short lengths cut from the frame of the same truck that provided the transmission were used to suspend the assembly under the ceiling.—*R. H. Peters, East Holliston, Mass.*

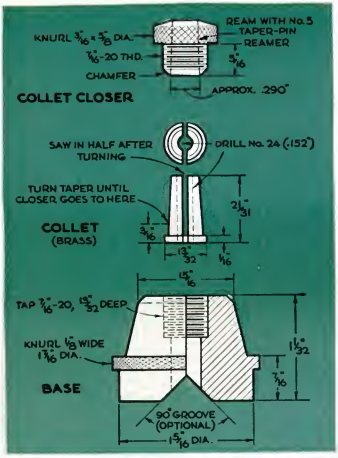


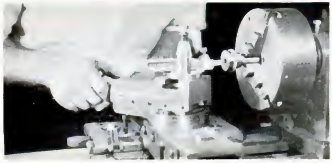
Measuring for V Belts. After measuring around two pulleys with a cord and as a result buying too short a V belt, I used a flexible steel tape for the job. Being ½" wide, it measured right on that width of the V pulleys, giving the correct length for a ½" V belt.—*Art Coberly, Anderson, Ind.*



Shaft length is checked by reading indicator on surface gauge. This is then moved over micrometer, which is adjusted for same reading.

Surface gauge is set with micrometer to scribe precise layout lines. Tilt the scriber downward to insure contact with its extreme point.





Face the base on a mandrel threaded in the lathe. Base must hold mike absolutely square.

Fixture Converts Inside Mike to Accurate Height Gauge

YOU may have wanted a vernier height gauge, until you priced them. It's good news, therefore, that you can have the same accuracy at the price of a relatively inexpensive inside micrometer. All you need is a lathe-made fixture to hold the mike upright.

The fixture consists of a base, a collet to grip the micrometer rods in the base, and a collet closer. Machine the base on the end of a piece of bar stock, threaded nose out. Cut it off, and thread a matching mandrel on the lathe. Screw the base on the mandrel to face the bottom square. The groove is for use on round stock but may be omitted.

Knurl, thread, and taper-ream the collet closer. Cut off and rechuck, knurled end out, to crown the top slightly.

Machine the collet from brass. Turn a test taper with the compound, apply marking blue, and twist the closer on over it to try the fit. After drilling through, part off the collet and split it in two with a fine saw.

In using the setup, make sure the micrometer shaft is in contact with the surface from which measurements are being taken.—*L. W. Bonnell, San Diego, Calif.*

Midget Hot Rod Hits 40 M.P.H.

Short, high-revving prop and tapered tread on wheels make it just a blur at the end of its tether line.

By Jack Wilson

IMAGINE a 4-oz. car, driven by a 1-oz. power plant, clipping off two laps per second on a tether line—and you've got a blurry object that seems to be doing 1,000 m.p.h. It actually does 40 m.p.h., but when it stops, strangers look for wings.

A tiny model-airplane engine powers the Prop-rod. The car is shown above on a plywood track laid out in an 8′ 9″ circle on the lawn. A longer tether could be used, but by keeping the circle small you can operate the model indoors—perhaps in your garage.

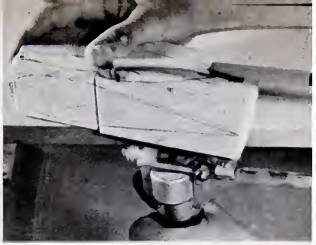
Model-airplane building tools are all you need to make it. Allow an evening for shaping and assembling the parts, and another for painting and finishing.

What engine to use? That's your first choice. The accompanying drawings are for the Infant Torpedo®. If you use another engine, check it against the plans and alter them to suit. In the template cross section allow at least 5/32″ clearance all around. If necessary, the glow plug can protrude from the bottom of the car body. Differently spaced mounting lugs on some engines will also require a slight alteration of the firewall design.

After shaping the body from balsa, drill a ½″ hole in the bottom for a hardwood plug. The axle assembly is bolted to this. Make holes in the sides for the fuel line and the needle-valve knob and another underneath for access to the glow plug. The latter is also the fuel-drain hole.

Mounting the engine. Cement nuts for the engine-mounting screws to the back of the firewall. Solder a piece of wire to one nut and run it through a hole in the side of the body. This serves as a ground connection for the starting battery. Connect the other battery clip to the glow plug through the hole in the cowl bottom.

If you are satisfied with speeds up to 25 m.p.h., you can use a stock metal propeller, tank, and wide-tread model wheels. For higher speeds, the prop must be cut down so it will wind up to a screaming 16,000 r.p.m., and tires must be tapered to a smooth, narrow tread to reduce friction. Then the car should reach 35–40 m.p.h.

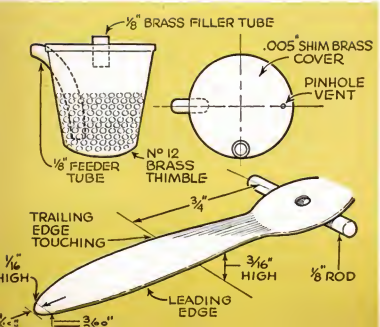


Saw the body from a balsa block. Cut top outline first, as at left, sawing just outside line. Trace side outline with side waste pinned or cemented back in place temporarily. Saw away bottom. Then cut off cowl section (center) and cement it lightly back in place. When cement has set, cut away rest of side (right). Electric jigsaw does a smooth job on balsa.

Rasp or carve the body to rough shape. Finish with coarse and fine sandpaper. Check at firewall position with a template made from the drawing on facing page. Don't make it too narrow or engine won't go in. After removing the cowl top, hollow the body to fit engine. Also hollow lower part of the firewall for gas tank, and drill ½" hole for hardwood plug.

Shaping a high-speed prop. For tops in speed, Lud Kading, designer of the Infant Torpedo, recommends a 3¼" propeller of 6" to 7" true pitch. He suggests the following procedure to approximate this with ordinary tools:

Cut the regular 4½" metal prop to the 3¼" shown in the drawing. File the front face to airfoil shape, tapering the trailing edges to knife sharpness. Check the pitch angle by resting the hub on a ⅛" rod on a flat surface. At a point ¾" from the hub hole, raise the leading edge 3/16" while the trailing edge touches the work surface. At 1/16" from the tip, raise the leading edge 3/32", the trailing edge 1/16". Maximum pitch is near the hub. It flattens out toward the tips. The aluminum spinner shown is a standard model-shop item.

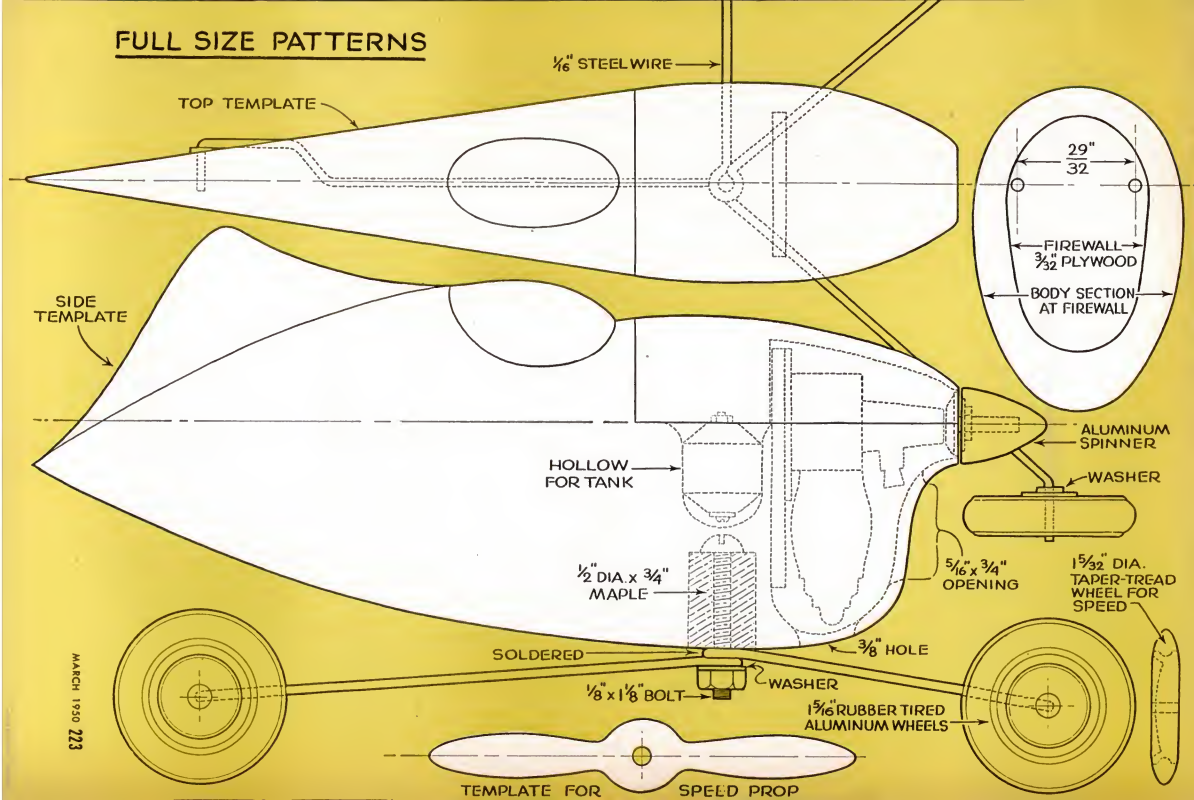


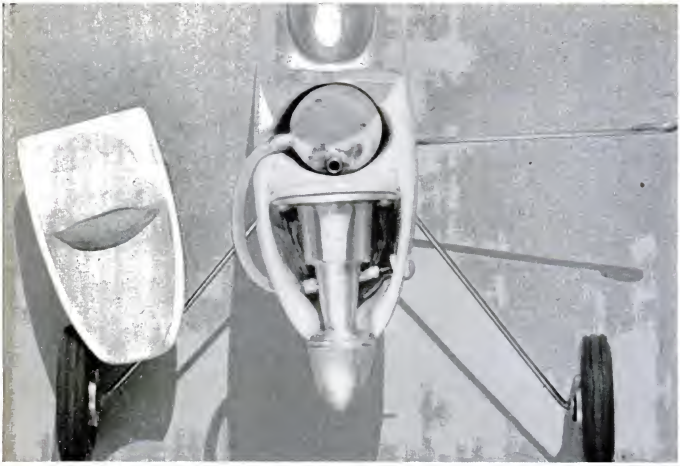
Cutting the cooling vents. For the high speeds that such a short prop will give, it is best to cut cooling vents in the sides of the cowl. Those shown are ¾" high and ¼" wide at the widest part of the arc. Locate them at the firewall corners.

Making the fuel tank. For a longer run, you'll need a larger fuel tank. This can be made from a No. 12 brass thimble, available in a dime store. A spring made by winding No. 28 brass spring wire around a 1/16" rod will keep a long fuel line from kinking. But in the fast model shown, the feed pipe is at such an angle that no anti-kink spring is needed.

The axle assembly. Coat the mounting screw with glue and thread it into a ½" hardwood plug. Cement the plug into the hole in the bottom of the car body.

FULL SIZE PATTERNS





Brass-thimble tank holds ⅛ oz. of fuel. This is enough for 45 laps. To prime engine, fuel can be squirted into cylinder through vent in cowl front. Friction keeps cowl top in place.

A nut on the screw secures the axles and the tether anchor. Bend the latter upward so its end is slightly higher than the inside wheel. Washers soldered to the axles on either side of the wheels prevent wobble.

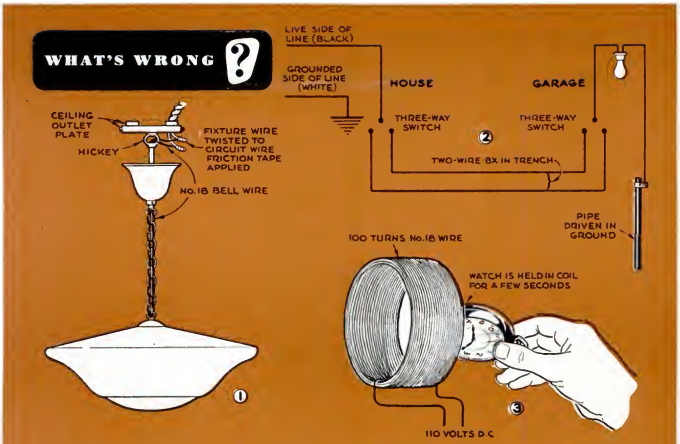
Applying finish. Make filler by mixing fuller's earth or talcum powder with clear dope to a thin paste. Apply three coats. Then give the model two coats of clear dope and five of colored dope, apply any decals you wish, a final coat of clear dope, and hot-fuel proofer. Aluminum dope simulates the cockpit.

Running the model. Make the tether of .010″ or larger steel wire. For safety, give it a pull test of 20 times the car's weight. A nail will serve as a center pivot.

At top speed, these cars are bound to throw some fuel, leaving an oily ring behind. The fuel will ruin any painted surface. Remember this in picking a spot for your track. END

Slow model does 25 m.p.h. equipped with standard prop and wheels. Countersunk needle-valve knob is slotted for screwdriver adjustment.

Fast model has shorter prop and wheels with narrowed tread to cut friction. Cooling vents in side are advisable for high-speed racing.



ELECTRICAL errors are often like delayed-action fuses: everything is quiet for a while, then there is a flash and a bang and you know you've made a mistake.

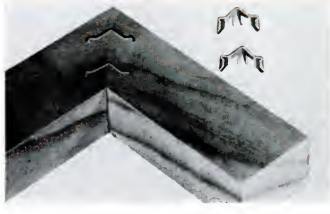
Rewiring the hanging chain fixture (No. 1) made the light work again. The garage light (No. 2) with switches at both the garage and house also looked good. The builder used material he had, and then improvised a return lead. Number 3 looks familiar, but is this the way you'd demagnetize a watch?

Answers

1. For use on 115 volts, bell wire is definitely not approved. Movement of the chain will quickly wear through the waxed cotton insulation. And remember that stranded—not solid—wire should always be used where there's motion. Unless solderless connectors are used, joints must be soldered and wrapped with rubber *and* friction tape.

2. The fellow who wired this setup thought he was clever because he made use of some two-wire BX he happened to have. After planning it in a trench he discovered that a third wire is needed for the two-way switching system, so he outdid himself and fabbed a pipe into the earth to act as a ground return. Both in money and time, he outsmarted himself, for BX isn't made for underground service. You need water- and rust-resistant conduit or cable. Also the ground return isn't dependable in dry weather and the lights will probably go dim. Then, too, electrical and fire laws are all against this practice.

3. If you come out of this experiment unfried, your watch will still be no better off. Passing 115 volts DC through 100 turns of No. 18 wire will just burn up the wire. Besides, DC doesn't demagnetize. You have to use AC and a coil with more turns of finer wire, passing the watch through it.

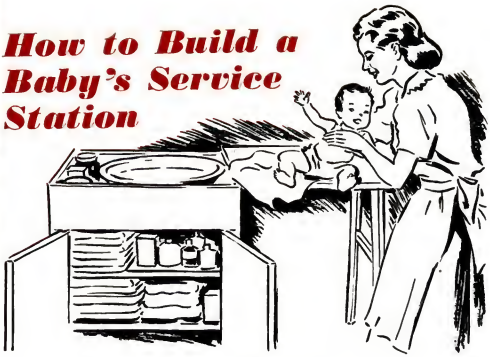


Fastener Holds Miter Joints

THESE steel fasteners, called Chevrons®, can be hammered into wood to make strong miter joints. They can be countersunk and concealed with composition wood. E. B. Packard Co., Inc., New York City, markets them in four depths: ¼″, ⅜″, ½″, and ⅝″. The ⅜″ size retails at 25 cents for a box of 30. When driven into a joint, the outside legs of the fastener are anchored across the grain of the wood to hold the fastener firmly.

Construction of baby's bath station is simple. You don't need any power tools. Unit is compact but has ample space.

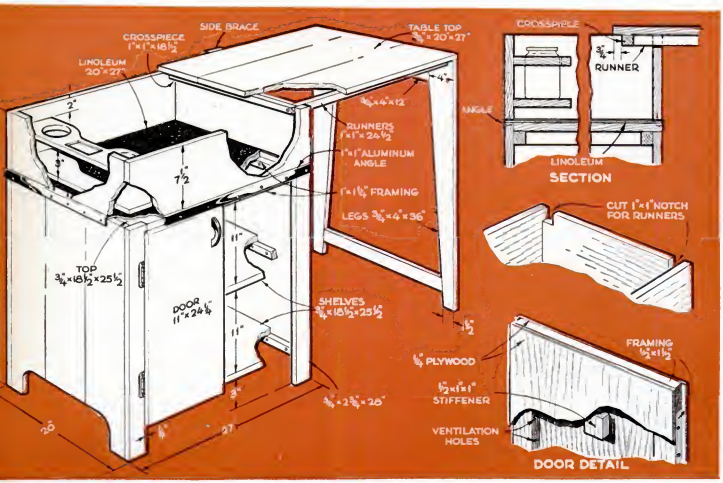
How to Build a Baby's Service Station



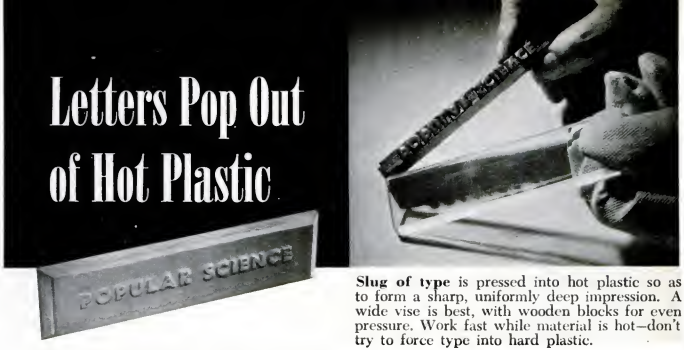
EVERYTHING mother needs to bathe and dress baby is right at hand in this combination cabinet and table. It provides space for a basin and, when opened, a dressing table beside it to which baby can be easily transferred. Clothing and supplies are within easy reach and the basin is easier to clean than a fabric tub.

Construction details and dimensions are shown in the drawing below. The unit is made of ¾" pine except for the doors. These are built up of ¼" plywood as shown. The linoleum, anchored all around with aluminum angle pieces, keeps any spilled water out of the storage space. Make the openings for the soap dish and jars of cotton and sterile water to suit the ones you have. The front is decorated with decals.

As an added advantage—when Junior graduates to the family bath tub—you can remove the top section and use the cabinet alongside a bed or as a general storage cabinet in the kitchen or cellar.—*Mary A. Bastedo, Washington, D. C.*



Letters Pop Out of Hot Plastic



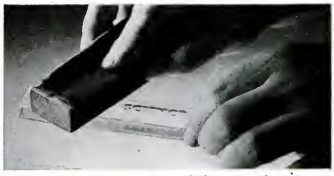
Slug of type is pressed into hot plastic so as to form a sharp, uniformly deep impression. A wide vise is best, with wooden blocks for even pressure. Work fast while material is hot—don't try to force type into hard plastic.

NOW you see it, now you don't—and here it comes again. That's the astonishing sequence in which raised printing can be formed on acrylic plastic by a method reminiscent of spies and secret codes, but actually as down-to-earth as your workbench.

You can use this technique to form raised lettering on signs, plaques, displays, ornaments, or other objects made of Lucite® or Plexiglas®. Since the process calls for a Linotype slug, it involves a small investment that may not be worth while for single pieces. Runs of even modest quantities, on the other hand, can be made at low cost, and the craftsman may find it profitable to make raised-letter specialties.

The Linotype slug, which you can have made at a newspaper plant or large printing establishment, is first pressed into the hot acrylic. This compresses the plastic directly under the letters. The surrounding material is then sanded completely away, so that the sunken letters vanish, and the surface is polished. When the piece is again heated, the compressed material expands to its normal height, standing out in relief.

Embossed designs can also be reproduced this way, but the relief must be uniform in height. If it isn't, the more shallow portions will probably be lost.—*M. J. Moch, Queens, N. Y.*



A clean-cut impression of the type face is required, but it should not be so deep that it shows corners of the slug. Next step is to file or sand entire surface down to bottom of sunken letters. Then polish. Letters no longer show.

They pop back permanently as the piece is again heated. Electric hot plate was used for these photos, but in practice an oven is required. A power sander is almost a necessity for quantity work—hand sanding or filing is too slow.

Oil Smooths Zipper Action

STIFFNESS, locking, and tearing of slide fasteners are sometimes caused by lack of lubrication. Dry cleaning and normal evaporation tend to keep a fastener dry, but this can easily be remedied. Moisten a clean cloth with a few drops of oil and wipe the fastener. The treatment should be repeated after every other dry cleaning.—*John W. Nestler, Tampa, Fla.*

Glue Fills Plaster Cracks

HAIRLINE cracks that sometimes develop in plastered walls should be filled before painting. For a neat job, mix some glue or glue size with plaster. The glue should be about the consistency of thin syrup before it is mixed. Work the mixture into the crack with the fingers and dress the surface with a putty knife if necessary. It should be left to dry for a day or so before painting.—*Joseph E. Bird, Carrollton, Ill.*

The graceful and familiar style of this table blends with furniture of almost any period. Its understructure shows traces of the Roman folding stool and Gothic English chair.

To fold the table for storage in minimum space, you only have to grasp the two outer edges and press them down. To move the table without folding it, lift it by the same edges.

Photos by Wally Kunkle

Service Table Folds Away

THIS English tea table, handy for side service or as an occasional or card table, doesn't know how to get in the way. Top and legs fold up for compact storage.

Sawed Parts: Enlarge the grid of squares and trace off the leg profile onto a piece of walnut, maple, or other hardwood. You can save stock by nesting two or more legs in a large board. Thickness is ¾″.

Cut out the legs, clamp them together, and drill pivot holes through all four pieces at once. Make a 3/16″ hole near the top and another about 13¾″ down. Enlarge the center hole to 9/16″ on two pieces. These will be the inner legs.

For the top, saw two ½″ by 9⅜″ by 24″ boards. Round the corners, ends, and outer edges, but leave the inner edges square.

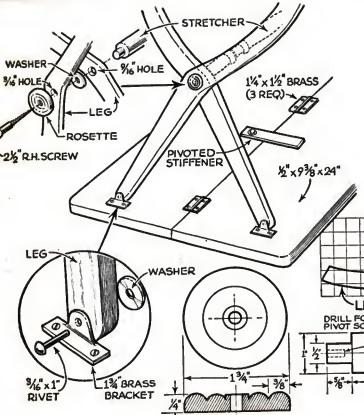
Turned Parts: A lathe is handy for turning the stretcher and rosettes, but it isn't essential. The stretcher may be hand-carved, or a straight dowel with ½″ by ⅜″ tenons at both ends will serve. Rosettes can be almost any disks of proper size. Particularly good ones can be obtained by slicing off the tops of decorative drawer knobs.

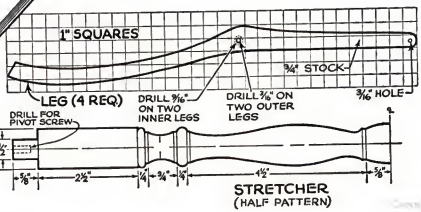
Assembling the Pieces: Join the squared edges of the table top with three brass hinges. Fasten one in the middle, the others about 2½″ from the ends.

The understructure is held together by 2½″ roundhead screws as shown in the sketch. Note that the inside legs (those that go on the stretcher first) come out on the same half of the table.

Rivet a brass bracket of the type shown to the top of each leg. Open the table top, face down, and put the legs in place. Center the assembly lengthwise and screw down the brackets 4¾″ each side of the center.

Its own weight serves to hold the table open, but for extra security, pivot a 10″ stiffener strip under one leaf. Turning the strip so that it laps both halves locks the table.—*Norbert Engels, South Bend, Ind.*





16-Inch Tube Modernizes 10-Inch Set

Here are the raw materials of big-screen TV: An old 630-type 10-inch receiver, a larger cabinet, a 16AP4 metal or 15DP4 glass kinescope, mounting hardware, and a 27,000-ohm resistor (arrow).

Changing one resistor in a small chassis may enable you to enjoy TV pictures that are 2½ times larger.

By Robert Gorman
PS photos by W. W. Morris

SEVERAL hundred thousand 10-inch television sets now in use have enough power built into them to drive 16-inch picture tubes. Yours may be one.

It is if it uses the RCA 630-type circuit. Sets of this design were widely distributed from 1946 to 1948 and later. They first appeared under the RCA label and then under a score of other well-known brands. The "6" stands for 1946 and "30" is the number of tubes including rectifiers and kinescope.

I had one of these sets—built from a kit as described in PS of April '49, p. 226. Following the present trend to king-size pictures, I decided to convert my small set for big-screen operation.

But how?

I found the answer in a leading TV lab. Engineers who wouldn't have been afraid to tackle big wiring jobs were making the change I wanted simply *by adding one resistor.*

Electronically it's as simple as that. The resulting performance matches the quality of any 16-inch receiver.

Making the change, however, involves a few fussy mechanical problems that stem from variations in tube size, mounting hardware, and cabinet dimensions.

Tubes: Among the picture tubes that can be used are the 16AP4 (metal shell), 15DP4 (glass type) and 12LP4 (12-inch,

1 **I began** by taking the old cabinet apart. In most cases the top lifts off or unscrews. Then the front mask and safety glass can be unscrewed from the inside.

2 **The second-anode connector**—the high-voltage cap that plugs into the glass near the bulb end of the picture tube—lifts out. Stored juice is discharged by grounding it.

3 **I slipped the ion trap** off the neck of the big tube after removing the tube socket. This trap is of the permanent-magnet type. Some traps are wired into the circuit.

glass). They all have the same socket arrangement as the original 10BP4. Their cost ranges from about $30 to $75.

Brackets: These are available in different styles in both wood and metal. A set consists of a cradle or ring support for the tube face and a platform for raising the yokes that fit around the neck of the tube.

Cabinets: Since mounting hardware isn't uniform it's important to see that the cabinet matches the modified chassis. The height of the tube face must correspond with the picture window. The speaker also has to be moved from its original place. Make sure that the speaker opening isn't in the way of the tube holder.

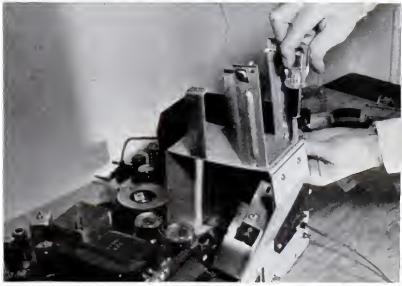
Another approach is to build a cabinet from scratch. You'll not only get what you want but also save money. The following article gives details on constructing a table-model cabinet to suit your TV chassis.

Watch Out!

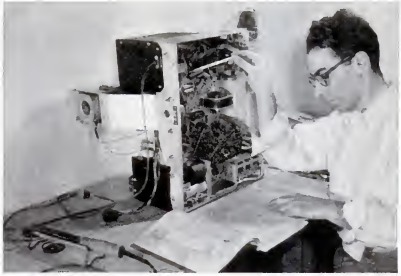
Beware of high voltage and picture-tube breakage.

Pull the power plug before you look inside the cabinet. Also be sure to discharge the capacitors by grounding the second-anode button to the chassis. If you have to extend the second-anode lead, use wire with at least 15,000-volt insulation. For other extensions, use 2,000-volt insulation.

Handle picture tubes by the bulb only, and treat them with respect.



7 **I attached an elevated platform** to the chassis and mounted the coil brackets on top of the platform. It's part of the mounting hardware I bought for my conversion.

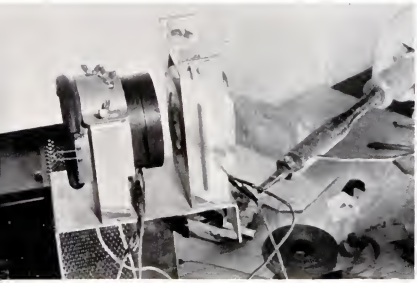


10 **The new resistor** is soldered to pin 8 of the 6BG6-G. This is the horizontal sweep output tube and is located inside the high-voltage compartment. Diagram helps to locate tube.

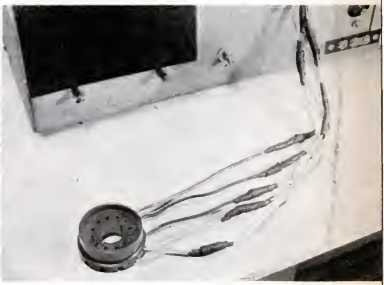
4 **Next, I slipped out the tube** and put it away carefully. I then pulled off the knobs, loosened the chassis bolts under the cabinet, and pulled out the chassis.

5 **The focus coil** is supported in a metal bracket. The coil is removed from the bracket; then the supporting frame is unbolted from the chassis with a socket wrench.

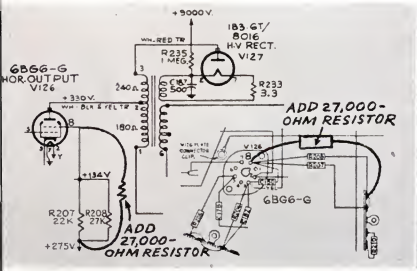
6 **The deflection yoke** also has to come off so its bracket can be removed. Loosening three wing nuts frees the yoke from its frame. Wires have to be lengthened.



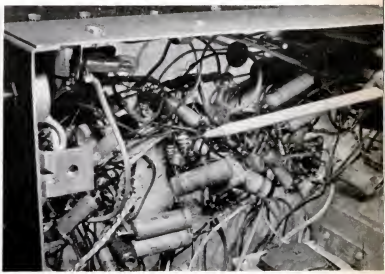
8 **After determining the position** of the platform, I removed the rear leg to reach the deflection- and focus-coil wires. These have to be extended to reach the new coil locations.



9 **Leads for tube socket** also had to be extended. I cut the five wires in staggered steps for increased safety. Even if the tape slips off, the splices aren't likely to short.



11 **These diagrams** of related socket connections are adapted from the RCA service manual. Resistors 207 and 208 are already in parallel. The new unit shunts them both.

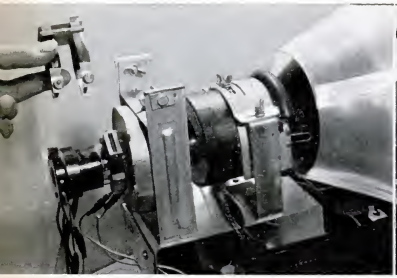


12 **Pencil points to 27,000-ohm,** 2-watt resistor added to circuit. Its effect is to decrease screen resistance and increase voltage on primary of high-voltage transformer.

13 The entire metal shell of the 16AP4 is "hot," so it's wise to cover it with a plastic insulating hood and ring. The brackets I bought had a metal ring support.

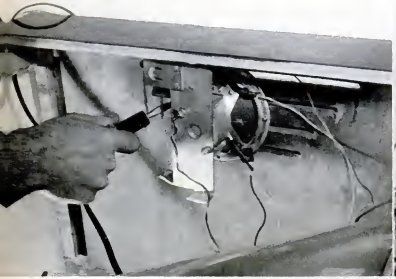
14 The chassis crossbar that holds the tube mount was drilled for the legs of the supporting ring, but the holes were in the wrong places. I redrilled them to fit.

15 The right way to mount the crossbar is with the flat side to the front. However this made the tube sit too far back, so I reversed the bar. It's held by control nuts.



16 Another change I didn't expect to make concerned the ion trap. The neck of the 16-inch tube is about 1 inch shorter than the old 10 incher, so I substituted a narrower trap.

17 Tuning the set consists of resetting the six rear controls as well as adjusting the ion trap, and focus and deflection coils. I wore gloves while I was working near tube neck.



18 After set was pushed into cabinet I remounted the speaker in its new location, frame and all. Leads have to be extended, and it's essential to ground speaker frame to chassis.

19 Here's my new TV receiver, up-to-date again. When I got my 10 incher, big tubes were scarce, but they're not any more, and the current trend is in the direction of larger screens.

Save Money by Making Your Own Television Cabinet

Cabinets add a chunk to TV prices. Here's how you can economize, whether you're buying or converting.

IF YOU put a larger tube in your TV receiver, as described in the preceding pages, you can make your own cabinet *to the right dimensions* for far less than a ready-built one would cost.

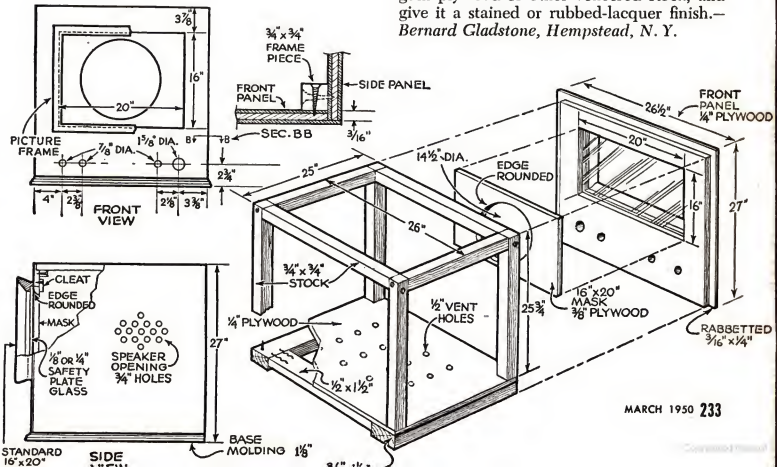
And if you're still shopping for a TV set, you can save money by buying a kit or wired chassis and putting it in a home-made cabinet. The dimensions given in the drawing below are for an RCA type 630 chassis, but by changing dimensions the same construction can be used for any set.

Checking the Dimensions: Place your set's chassis with mounted picture tube on a flat table. Measure the distance from the table to the highest point on the tube. This plus 2½″ is the inside height of the cabinet. For the height of the front panel add 1″ for overlapping the base and an extra ¾″ for the top rabbet. To get the outside width of the front panel, measure the chassis at its widest point and add 4″. Overall length of the chassis, plus 3″ or 4″ gives the depth.

Marking the Panel: On most chassis the picture tube is placed in the center, so the front panel has to be marked off symmetrically. Cut a sheet of cardboard to the height and width of the panel and draw a center line from top to bottom. Hold the cardboard against the front of the set with the line bisecting the tube face and press it against the control shafts to mark their position. Without moving the sheet, mark the points where the top and bottom of the tube face cross the center line. These two points represent the top and bottom of the rectangular picture-frame opening.

Constructing the Cabinet: When you have settled on the dimensions, cut out stock to suit. For the base, make a rectangular frame. Use ¾″ by 1½″ stock for front and sides. For the rear member use a piece ½″ thick to allow some ventilation from below. Cover the frame with ¼″ plywood.

Mount the ¾″ by ¾″ uprights on the base with long screws and glue. Do the same with the top crosspieces. Then cover it with gum plywood or other veneered stock, and give it a stained or rubbed-lacquer finish.—*Bernard Gladstone, Hempstead, N. Y.*



I'd like to see them make . . .

Everybody has his own pet idea of some gadget he would like to see in general use. What is YOURS? *Popular Science* will pay $5.00 for each one published. Use government postcards only. Contributions cannot be acknowledged or returned.

Calibrations etched on the stationary jaws of adjustable-end wrenches. These would enable you to set the wrench accurately for the size of nut or bolt you wanted to turn.—*Richard M. Colbert, Baltimore, Md.*

A flexible attachment for tank-type cleaners. This could be similar to the stem of a gooseneck lamp. You could use it to get into spots that are too small for other attachments.—*Esther L. Bigley, Athens, Ohio.*

Nylon floor mops. Big advantage of such mops would be their speedy drying after you used them. You wouldn't have to park a wet mop in a storage closet. They'd also wear longer.—*Mrs. John La Van, Bethlehem, Pa.*

Removable plastic liners for kitchen garbage pails. These would be easy to take out of the pail for cleaning, and they would prevent rust from forming in the bottom of the pail.—*James Wilson, Manhattan, N. Y.*

Twist drills with the sizes stamped on the ends instead of on the shanks. Lots of times a drill will slip in the chuck. After a few slips, the number is usually worn off.—*H. G. Radcliffe, Petersburg, Va.*

Kodak Pony for Color

EQUIPPED with an f/4.5 lens and built-in flash synchronizer, the $30 Kodak Pony 828 Camera® has been developed especially for amateur color photography. Shutter speeds range from 1/25 to 1/200 second, plus bulb; the lens focuses from 2½ feet to infinity. For simplicity, standard shutter-speed and opening settings for bright sunlight with Plus-X® film are marked in red.

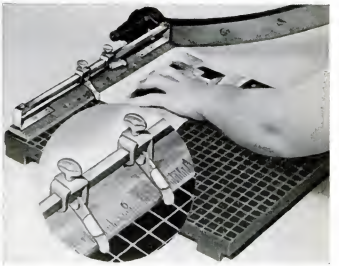
The Height of Ingenuity

• Junior was getting into places where he had no business—especially the drawers in my shop. I rigged up a gadget that not only startled him but also let me know when he opened a drawer. What was my alarm?

I hooked up a mouse trap and an old alarm clock. I just wound the alarm spring; not the main spring. Then I tied a string from the alarm control to the trap. As long as the drawer was closed, the trap couldn't snap. When the drawer was pulled out, the trap cleared the top of the bench, snapped, and set off the alarm.—Richard Reichelt, Chicago.

Plastic Pulls Are Luminous

SCRAP pieces of clear plastic, drilled and filled inside with a little luminous paint, make excellent pulls for overhead light cords. Almost any kind of scrap will do; flat stock can be hollowed out by internal carving, and bar stock can be turned, drilled, and polished at one chucking in the lathe or drill press. Design possibilities are endless, ranging from simple freehand turnings to elaborate miniature lamps. With flat stock, other possible designs include geometrical shapes, hearts, diamonds, small figures, and tiny models as in costume-jewelry miniatures.



Stop Aids Cutting in Dark

WHEN you trim a batch of photos or cut film to a smaller size, the new Trim-True® shown here will give you uniform sizes. Properly set, the two stops serve as your eyes while you are cutting film in total darkness. One gives the right width, the other the correct length to fit the holder. Trim-True is a product of the Webster Instrument Company, Los Angeles, Calif.

Chemical Enlarger Stretches

New process enables you to turn a transparency into a big print in its natural colors—without an enlarger and in broad daylight.

PS photos by Hubert Luckett

ONE day this winter a professional photographer stopped before a counter in a New York store where a demonstrator was explaining a new process for making color photos. A moment later, he interrupted.

"But how can you stretch a transparency?" he asked. "I'll have to see *that!*"

"It's just the emulsion that stretches," the demonstrator replied, "not the whole transparency. First you scrape off the gelatin backing as I'm doing and dissolve the film base. Then when you drop the emulsion into a chemical bath, it stretches—or, more correctly, it expands by itself."

"And it looks just like a limp rag," a spectator commented.

"But doesn't expansion weaken the colors?" the photographer asked.

For answer, the demonstrator indicated a color print and a backlighted transparency. "At the start," he said, "these were identical transparencies."

The photographer picked up the print—made by applying the expanded transparency emulsion to a white paper backing—and examined it closely. Then he compared it with the illuminated transparency.

"I wouldn't have believed it!" he said.

DEVELOPED by the Larjachrome Corp., of New York, this new process produces prints with colors as natural as those of the transparency itself. The amount of expansion varies, but you usually get a print about twice the size of the original transparency. And the cost per print is far less than for other procedures.

Making a print takes about half an hour. In addition to a kit of materials supplied by Larjachrome, you need only ordinary photo equipment. Here are the steps:

1 Soak transparency and a sheet of temporary support paper in water at 70° F. for five minutes. Use paper about 1" larger than transparency. It comes with kit.

2 Place wet transparency on a sheet of glass with its emulsion side down.

3 Scrape off the gelatin backing with a razor blade. Scrape well into the film base. For 35-mm. and 828 slides, omit this step. They have no gelatin backing.

Kodachromes

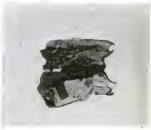
4 Squeegee transparency and temporary support paper together face to face. Then squeegee the assembly on a ferrotype tin with paper on top. Let it dry.

5 Roll up the paper and film, immerse it in beaker or jar containing film-base solvent that comes with kit. Cover tightly and let stand until the film base loosens.

6 Base now peels off, leaving only the emulsion on support paper. Then soak some tissue with fresh solvent and clean the emulsion well Trim border from film.

7 Pour expansion solution at 150° F. into a tray containing the transparency. This solution is prepared from a powdered chemical that comes with Larjachrome kit.

8 After a minute or two the emulsion will loosen from the temporary support paper and begin to expand, assuming a wrinkled form. Let it expand fully.



9 Lift it carefully out of the water and carry to a water-filled tray in which you have placed a large sheet of final support paper, previously soaked in Larjachrome paper conditioner for about five minutes.

10 Float the emulsion on the water above the support paper and carefully unroll it, making sure the image is centered.

11 Grasping the paper at opposite edges, lift it and the unrolled transparency from the water. Bending the paper backwards will make this step easier.

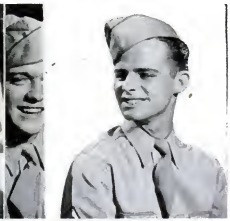
12 Smooth out the image on the paper with a wet brush, dry it, and your print is finished. In making a print this way, you lose the transparency, but this can be overcome by making a color duplicate first. At the present time, the Larjachrome process is recommended for use only with Kodachrome transparencies. END

Remove black spots by applying reducer sparingly with a brush. Take up any excess with a blotter before applying more. In portraits, you can lighten skin blemishes the same way.

How to Doctor Your Photos

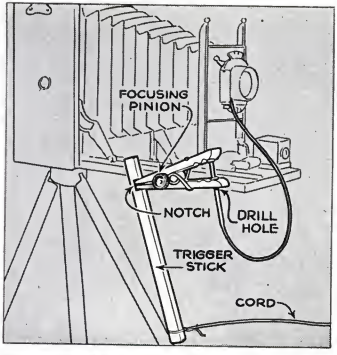
FARMER'S reducer sounds like something for fat men, but experienced photographers know it is an essential darkroom aid. Named for Howard Farmer, who discovered its photographic value in 1884, the solution is most commonly used in saving over-exposed and fogged negatives. But you can also put it to work on prints. A few of the ways are shown here.

You can buy the reducer or make it yourself. Prepare it as two stock solutions—the first, ½ oz. potassium ferricyanide in 8 oz. water; and the second, 8 oz. ordinary hypo in 32 oz. water. To use, add one part of the first to four of the second. Dilute this mixture further with from 8 to 32 parts of water, depending on the use.—*Kenneth M. Swezey, Brooklyn, N. Y.*



Pick a portrait from a group picture by outlining the desired figure with reducer. Apply solution to broad areas of photo with a cotton swab. Use a fine-pointed brush near the outlines. This will give you a white background, as seen at the right. After using reducer, aways fix print again in regular hypo and wash it thoroughly to prevent stains. For jobs like the one above, use the reducer strong. In all reducing, mix only enough of the two stock solutions to keep you going five minutes. The mixture decomposes rapidly.

Pep up clouds in prints like one at left by swabbing on a weak reducing solution. This will lighten them, as at right. You can also use this trick to add highlights and lighten any dark areas. Always stop a little before you have reached desired reduction, for it may continue slightly after you have removed the solution. Prints that have been over-exposed in the enlarger can be saved by placing in tray of weak reducer. Agitate the tray until entire print reduces to satisfactory point.



Clothespin Snaps Your Photo

HERE'S an easy and inexpensive way to get into your own pictures by remote control. When you pull the cord, the trigger stick falls off the clothespin. The pin snaps together, pressing the cable release. The clothespin is slipped over the focusing pinion.—*Hallie H. Holt, Springfield, Ill.*

Cement Stops Roof-Nail Leaks

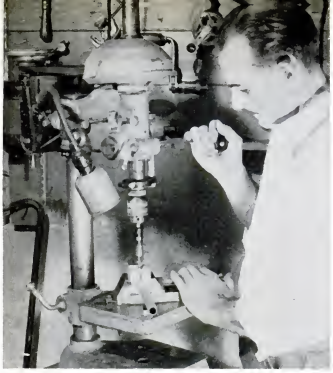
EVEN though nails in roll roofing may appear firm, they sometimes permit water to seep through. The remedy is to withdraw the nail, force roof cement into the hole, and renail.—*Dexter Allis, Billerica, Mass.*

Lazy Man's Chair Flops Over

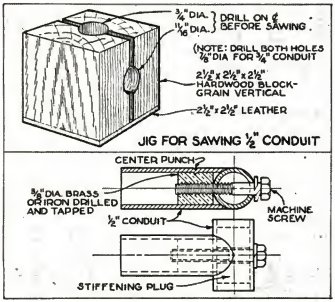
AN ENERGETIC half hour and a 12-foot board 14 inches wide will yield this lazy man's chair. Set one way (right), it's fine for reading; turned over (below), it's splendid for taking a nap.—*Grover Brinkman, Okawville, Ill.*

Drying Fan Blows Downward

BESIDES conserving space in a compact darkroom, I find that this film-drying setup offers two other advantages. Even with a rather strong air stream, the negatives don't whip about and stick together. Less dust is carried to them than with the customary horizontal setup. The rack was made from thin strips of wood and spring-type clothespins. Four 15-inch strips provide space for 24 negatives.—*F. T. Sokolik, Chicago.*



A hole saw chucked in a drill press cuts the joints to an exact fit. To clamp the conduit, you can make a jig as shown in drawing below.



You Can Do It With Conduit

Rigidly assembled, thin-wall tubing yields many useful items at little cost

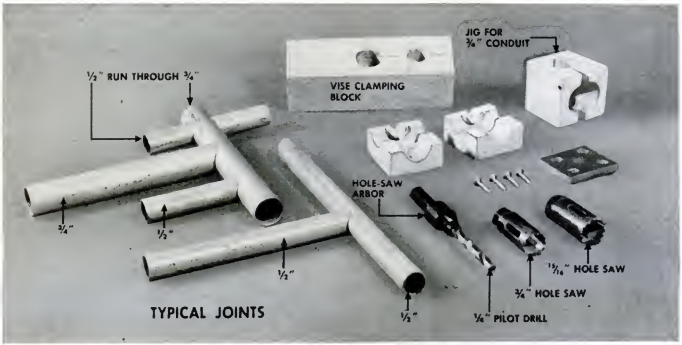
THIN-WALL conduit, a pipelike housing for electrical wires, can be put to many unexpected uses. By learning how to fit and fasten joints, you can turn it into handy items for the home, equipment for the shop, and sturdy toys for the children.

Made of galvanized steel, this conduit is light but strong. It resists rust—and can be painted or left unfinished. It can be bent quite easily. In ½" size, it costs about 70 cents per 10-foot length; in ¾", about a dollar for the same amount.

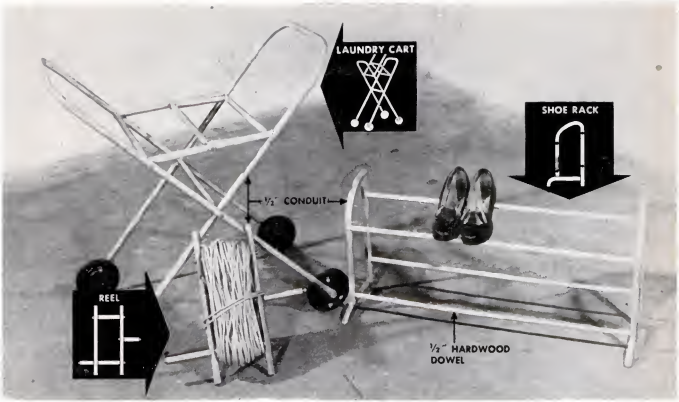
To fit the joints, chuck a hole saw in a drill press and clamp the conduit in a jig, made as shown from a 2½" by 2½" by 2½" block. A leather hinge screwed to the bottom of the jig permits opening to insert the conduit. Clamp this jig in the drill-press vise.

Centerpunch the conduit to help start the pilot drill. Extend the drill ⅞" to 1" below the saw so it will penetrate the opposite side of the conduit before the saws begins to cut. Run the saw at slow speed.

For assembling ½" conduit, cut through butting pieces with a ¾" hole saw. This gives a clean semicircular cut that fits snugly at right angles to another piece of ½"



The clamping block in background is handy for hacksawing the conduit to desired length.



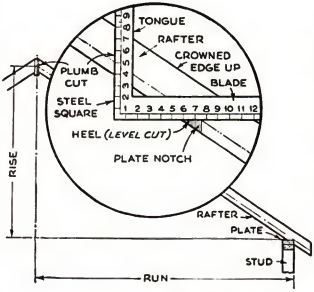
Here are some projects you can make. Conduit will bend without kinks if filled with sand.

conduit. For ¾" conduit, use a ⅞" hole saw. To fit ½" against ¾" conduit, cut the first with a 15/16" hole saw. The ¾" conduit can also be drilled through and an uncut piece of ½" run through it.

Brazing or welding gives good joints. But if you lack equipment for this, you can make the joint assembly as shown in the drawing on the facing page. A stiffening plug makes it possible to tighten the joint without collapsing the wall. For some joints, you can simply drive in a hardwood dowel and use a wood screw. For bolted joints, turn tight-fitting metal plugs, pin them in place, and then drill and tap them.

For the shoe rack shown in the photo above, the ½" dowel crosspieces were force-fitted after the conduit uprights had been drilled undersize (31/64") on one side only.—*C. M. Burkholder, La Grange, Ill.*

RAFTERS



The plumb and level cuts of a common rafter are determined by the rise and run of the roof pitch. The rise is the vertical distance between the plate and a point on the plumb cut which is located by extending a line along the rafter, parallel to its edge, at the depth of the plate notch. The run is the distance from the center to the outside of the plate. This is usually expressed in terms of inches rise per 12" of run. The sketch illustrates 8" in 12".

Lay the square on the stock with the figures coinciding with the crowned edge. A line drawn along the tongue is the guide for the plumb cut, and a line drawn along the blade is a guide for the level or heel cut.

The plate notch is usually cut 1" deep on the plumb for 2" by 4" stock. On wider rafters, cut deep enough to provide a 2" or greater bearing of the heel on the plate.

The same principle applies to cutting butted braces.

FOR YOUR POPULAR SCIENCE INFORMATION FILE

The owner of this 28-foot sloop pulled out his 4-cylinder inboard engine and substituted a 9-hp. outboard. Says he enjoys more room and a cleaner boat. He also installed an auxiliary fuel tank, shown being filled at left above. Tank is war-surplus oxygen container mounted under a seat. Gas line connects it with outboard's tank. Bicycle pump creates air pressure to move gas from auxiliary tank to outboard's tank.

Three Ways To Add Power To Your Sailboat

WITH outboard motors becoming more versatile and dependable, more owners of sailing craft are turning to them for auxiliary power plants. For boats with a high freeboard, shaft extensions are available to get the propeller down into the water. But in most cases, extensions aren't necessary. Three uses of outboards as auxiliaries, including a bracket mounting and a well installation, are shown here.

Here outboard is mounted on brackets bolted to transom. Some brackets are designed to handle motors weighing over 70 lb. A bracket can also be mounted on the side of a boat. This type keeps the propeller more constantly under water than the stern mounting, which may lift it spinning in the air as the stern rises out of the water on a pitch.

Well installation is shown here. Well consists of four-sided box built into stern section of boat. Box has open top and bottom. Motor hangs on bracket in forward side of box. Principle is same as that of a centerboard trunk. It must be tight and strong enough so that motor vibration won't cause leakage. Best installations of this type are put in when hull is built.

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in performance . . . in price

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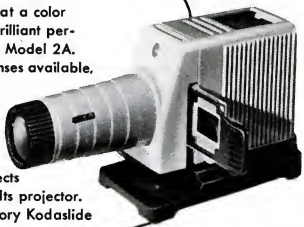
What a "throw"—what a color show! For all-round brilliant performance, look at the Model 2A. Two fine *Lumenized* lenses available, the Kodak Projection Ektanon 5-inch f/3.5 and the Kodak Projection Ektanon 7½-inch f/4. Heat-absorbing glass protects slides. Turn of knob tilts projector. Price, $47.50. Accessory Kodaslide Changer, $17.50.



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Navy Offers Films For Free Showings

THE U. S. Armed Forces have many 16-mm. sound films available for nonprofit, nontheatrical, educational screenings. The following titles are among those that may be borrowed from your nearest Naval District headquarters. Subsequent issues of PS will list films from the Army and Air Forces.

"Sea Power for Peace." A panoramic view of the U. S. Navy today. Black and white. Running time 9 minutes 7 seconds.

"Naval Photography in Science." The first comprehensive compilation of the uses of photography in the various fields of scientific research and development. Techniques utilized in the film to make presentation effective include: time lapse, high speed, slow motion, stroboscopic, microscopic, macroscopic, and underwater photography. Color sequences never before shown on the screen are included: the moon in motion, the blood circulation of a living brain, and a picturization of the earth as seen from 101 miles altitude. Kodachrome. Running time 28 minutes.

"Naval Photography in Intelligence." This film presents the story of naval photographic reconnaissance during the war and continues with the documentation of naval photography in the postwar era. It also demonstrates the uses of photography for industrial surveys and long-range topographic mapping. Black and white. Running time 17 minutes.

"U.S. Naval Academy." A documentary film depicting life at the U.S. Naval Academy. Kodachrome. Running time 39 minutes.

"Antarctic Expedition." The greatest expedition ever organized to explore the unknown. Navy's Operation Highjump takes its officers and men into the heart of the least-explored section of the earth to discover new peaks and mountains, map vast areas, and test cold-weather equipment. Black and white. Running time 18 minutes.

"The Zipper Fleet." A review of some of the historical background and heroic wartime activities that Naval planes and ships engaged in prior to their decommissioning. Picture shows the technical servicing necessary to keep them shipshape for long-term storage and swift call to action. Black and white. Running time 10 minutes.

"They Came to an Island." A picturization of how Sea Bees land on battle-fogged beaches and make roads. Using bulldozers, the Sea Bees build bases and lay out landing fields in record-breaking time. Black and white. Running time 35 minutes.

"Silent Service." A documentary film of submarine service in World War II showing the destruction of Japanese shipping in authentic, on-the-scene photography. Kodachrome. Running time 38 minutes.

"Operation Crossroads." This film shows Able Day and Baker Day blasts of the atomic-bomb tests at Bikini, produced by joint Army-Navy Task Force One. Kodachrome. Running time 27 minutes.

"Atomic-Bomb Test—Bikini Island." A film about the atomic tests at Bikini, compiled by editors of Paramount News, including the best public-release picture of tests Able and Baker. Black and white. Running time 18 minutes.

"One-Man Task Force." This film demonstrates the im-

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The Gearshift Motor with the "All-Day" Tank

● Here's the happy combination for boating fun! A great new Evinrude packed with eager performance! 14 horsepower* for thrilling speed! With *Gearshift Control*... you start in *Neutral*... back away from docks... maneuver with finger-tip ease. Separate *Cruis-a-Day Tank* provides fuel for an average day's running without re-fueling. Plug fuel hose into motor—stow tank anywhere! *Quik-Chek Fuel Gauge* tells you supply at a glance!

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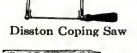

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portance and variety of use of long-range, shore-based air in the Navy. Black and white. Running time 38 minutes.

"History of Lighter-than-Air Rigid Airships." Title is self-explanatory. Black and white. Running time 40 minutes.

"The Fleet that Came to Stay." The invasion of Okinawa is told from the Navy's point of view. The film shows naval action at the time of the landing, the dramatic attack by the Kamikaze, and our counterattack. The picture explains why it was necessary for our fleet to remain at that base even under constant attack from land-based Japanese planes. Black and white. Running time 38 minutes.

"Prelude to Victory." The story of the Eighth Fleet and its advances from the shores of North Africa to final victory on the Italian beaches. The fury of the Luftwaffe in its last desperate attempt to annihilate the invasion forces provides many excellent combat scenes. Black and white. Running time 40 minutes.

"Sea Power in the Pacific." An interesting picturization of the importance of sea power and its great mobility. Combat shots are combined with animation sequences to show the part played by sea power in the advance across the Pacific. Black and white. Running time 30 minutes.

"Fury in the Pacific." This picture concerns the operations against and the capture of the Islands of Peleliu and Anguar, the airstrips that were needed to protect the subsequent Philippine invasion. The immensity and ferocity of aerial and off-shore bombardments are highlighted. In the photographing of these scenes 10 cameramen of a crew of 39 were casualties. Black and white. Running time 20 minutes.

"To the Shores of Iwo Jima." A color film showing the Marines' struggle against this heavily fortified island in the Pacific. Running time 20 minutes.

"Brought to Action." This film is about the part the Navy played in the second battle of the Philippines that began on October 19, 1944. Depicting some of the heaviest action in the Pacific war, the picture illustrates the Japanese plan of a pincer movement on Leyte as well as the Navy's counterattack plan. Black and white. Running time 21 minutes.

"Of Liberal Education." This is the story of the Naval Reserve Officers Training Corps. It shows various phases of NROTC, and an NROTC student's activities from the time he takes his aptitude tests until he graduates and receives his commission. Kodachrome. Running time 20 minutes.

"Naval Chapels in the Pacific." This film opens with a Naval unit preparing to leave for bases in the Pacific. The work of the Navy chaplain aboard ship and upon arrival at a Pacific island base is described. Beginning with church services held in the open, the film points to the need for places of worship and describes the construction of various kinds of chapels, in particular the "stick-and-canvas," thatched-roof, and quonset types. Kodachrome. Running time 12 minutes.

"Take Time for Tomorrow." This picture shows the educational opportunities available within the Armed Services to all military personnel. Academic and vocational courses are visually described, including many specific subjects in each course. The film shows how classes are conducted, materials prepared, correspondence lessons graded, and how to enroll for the study of a specific subject. Black and white. Running time 12 minutes.

"Army-Navy Football Game 1948." Kodachrome. Running time 35 minutes.

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ITS NEW SUPER-QUIET 100 h.p. V-8 WHISPERS QUALITY!

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New rotary door latch, with nylon-plastic shock absorber in striker plate — doors close silently and securely.

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Bundle of wires connects Bemac's mechanical section, at right, with electronic section.

Brain Tracks Missiles Without Firing Them

A BATTERY of electronic and mechanical equipment can now foretell the behavior of a guided missile long before it is ever fired. It's done by a new kind of electronic brain, the Bemac—short for "Boeing Electro-Mechanical Analogue Computer". It is designed for use in a Boeing ground-to-air pilotless-missile project for the Air Force.

The 3,000-vacuum-tube missile tracker consists of a shelf-mounted electronic section and a table-mounted mechanical section. Together, they occupy an 11-by-24-foot room in a Seattle, Wash., company laboratory. Here, without actually firing a missile, the new Bemac predicts and records its every movement and attitude from the time it leaves the ground until the instant it touches the earth again—just as if it *had* been fired. Each waver, dip, and spiral is accurately determined, and the exact time and location of the landing is registered.

Instead of using an actual model of a missile, engineers preset the Bemac to a combination of voltages and mechanical shaft positions that represent the missile. The sum of these *is* the missile in a mathematical sense, and it will act just like a missile. Then the engineers feed into the machine such known data as the nature,

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Fouling at low engine speeds—misfiring under heavy loads—failure due to heat shock—accumulation of oxide coating—these are primarily *insulator* troubles.

CORALOX is AC's patented Insulator. It has 4 times greater heat conductivity—10 times greater electrical resistance at high temperatures—than the best ceramic insulator material in use before *CORALOX*. It is 3 times as strong. It is basic in chemical composition.

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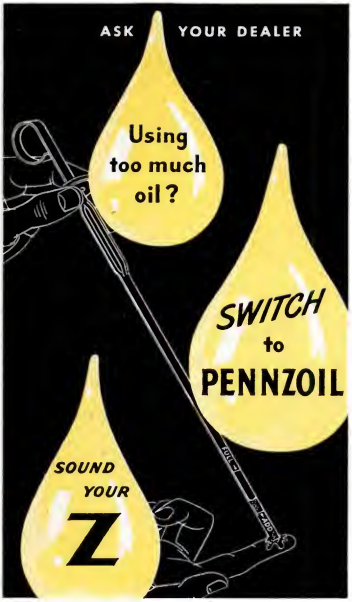

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strength, and direction of the propulsive force and significant atmospheric conditions.

Once they set the Bemac in action, the imaginary projectile is under way, with all of its motions faithfully simulated by the battery of electronic units. Its trajectory appears as moving series of dots on the viewing screen of an oscilloscope, giving an instant-by-instant picture of its flight path. A rapid-fire camera trained on the 'scope makes a permanent photographic record of the "flight." Its all-revealing photos are guarded from the public view.

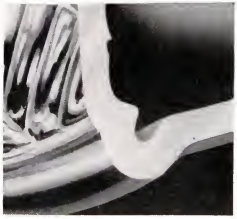
Unlike electrical brains that perform fabulous feats with long strings of digits, the Bemac does not work with numbers at all, but deals directly in motions. These include a missile's tendency to spiral or roll; its end-over-end motion, or pitch; its side-to-side swing, or yaw; its velocity; and its acceleration. All are constantly varying. Bemac will solve a problem involving as many as 20 of these variables at once. It could as easily foretell the path of a flying football, arrow, electron, old shoe, soup plate, or any other inanimate object not subject after launching to such unpredictable alterations as the flight of a bird, insect, or airplane.

At any point in its trajectory, the simulated projectile may be "stopped" in mid-air while the engineers reset the machine to represent a change in the setting of a guided missile's control surfaces. The Bemac then works out the corresponding new trajectory in a matter of minutes.

While the Bemac does not completely outmode the gathering of data by actual test firing, as is done at Alamogordo, N. M., its operators declare that the numerous problems it will solve will save thousands of dollars in time and material that would otherwise be expended in experimentation.

Jar Brackets for Hardware

THE brackets pictured above hold empty baby-food jars, offering visible storage and quick dispensing of small parts. Ideas Inc., Stratford, Conn., markets the brackets in six- and four-jar sizes at about 30 cents each.



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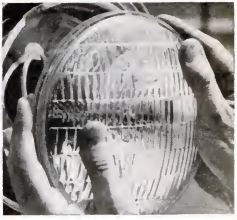

3. HARD-GLASS LENS resists shock—is precision-built to throw maximum light on the road. Have lights checked next time your car is serviced—and insist on G-E lamps for replacement.

You can put your confidence in—

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10 TIMES FASTER... FAR MORE ACCURATE... MUCH EASIER TO USE...

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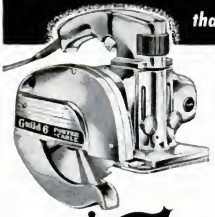

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Contact Printer Copies Tape Records

A NEW way to make "copies" of magnetic-tape recordings has put the recently developed magnetic system on an even footing with its older rivals—the disk-recorder and optical movie-film methods long in use. It can provide both cheap, professionally recorded tape for magnetic-tape phonographs and an easy new way to put the sound track on movie film.

The new copying method works something like the contact printing of movie film. The original recording, or "master," is run through a machine with the blank "copy" tape. Where the two tapes touch, a powerful magnet creates a rapidly varying magnetic field. This makes the magnetic particles in the copy tape line up the same way as the particles in the master, producing an exact duplicate of the original sound recording. Since the two tapes can be run through the duplicating machine at a fairly high speed, large quantities of copies can be produced quickly and cheaply.

Previously, the only way magnetic recordings could be duplicated was by rerecording from a master tape. Here signals from the master had to be picked up, amplified, and fed to a recording head that then copied them on a blank tape. Even with multiple recording (PS, April '49, p. 113), where several copy tapes were recorded simultaneously, the complex electronic equipment required and the time it took made the system too costly and slow to be commercially practical. Now the new system eliminates both obstacles, doing away with the expensive recording equipment and speeding up the recording rate.

Two research groups—both working at the same time, but without knowledge of each other's activities—figured out almost simultaneously how to remove this last stumbling block to the wider use of magnetic recording. Marvin Camras, Armour Research Foundation physicist who is responsible for much of the recent progress in this field, headed one team. The same day he reported his method, an almost identical system was announced by Minnesota Mining and Manufacturing Co., the firm that makes Scotch® tape and is also a leading producer of magnetic-recording tapes.

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Look at those MOTO-TOOL Features Dynamically balanced armature eliminates vibration. Oilless (oil-sealed) bearings ● Patented automatic chuck lock pin ● Snap-type sliding switch ● Cord protector ● Shockproof bakelite housing ● Dust-filtered air-cooling system ● Weighs 13 oz. ● Plugs into any 110-120 V. AC outlet. ● Backed by over 13 years use in plants of General Electric ● Ford ● Remington Arms ● Nash-Kelvinator ● Westinghouse ● Douglas Aircraft, etc. . . . plus a money-back Guarantee if not delighted after 5 days' trial.

Approx. 25,000 RPM

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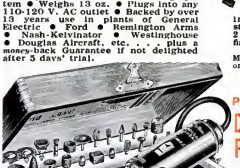
MOTO-TOOL KIT No. 2, with 23 accessories including high-speed steel cutters and Model 2 Moto-Tool in natural finish hardwood case **$23.50**

MOTO-TOOL No. 2 with one emery wheel point **$16.50**



Portable Drill Press

This 12" high, precision drill press is ideal for model making, wood carving, routing, etc. Utilizes No. 2 Moto-Tool. Only **$9.95** (Less Moto-Tool).

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CUTS SCROLLS LIKE MAGIC—SANDS AS IT SAWS

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Only **$5.85** with 3 saw blades

FREE PROJECT PLANS

For men who harbor a hobby or do their own repair work . . . for boys who like to make things . . . no other tool will give so much pleasure and satisfaction in the home or workshop for the small amount of money invested as a Dremel Electric Coping Saw. It works in any direction . . . delivers 7,200 strokes per minute . . . so easily, there is no effort . . . so smoothly, work needs no sanding. Saws through ¾" medium-hard wood at a foot-a-minute speed. Touch-of-the-trigger, foolproof action. Only two moving parts, never needs oiling. Operates on 110-120 V. AC. Thousands and thousands of satisfied users.

Plans for making six useful, decorative projects packed with each Dremel Electric Coping Saw.

MONEY BACK GUARANTEE. If your dealer cannot supply you, use coupon to order direct from factory for five day trial.

DREMEL MFG. CO., DEPT. 120-C, RACINE, WIS.

3 TOOLS IN ONE

Only **$14.85** POSTPAID

Patented

Dremel *Electric* SANDER POLISHER-MASSAGER

Say goodbye to hand sanding and polishing! This miracle machine is so easy to handle, a child can use it. Craftsmen and housewives find (1) **As a sander,** it takes the effort out of sanding walls, woodwork, furniture, workshop projects, etc. Its straight-line (non-rotary), action will not burn or scratch surfaces. (2) **As a polisher,** it does a professional job on waxed surfaces of cars, furniture, etc. (3) **As a massager,** it's ideal for tired or sore muscles.

Works Easily in Awkward Places

Sands Flat Surfaces Evenly

Makes Play of Wax Polishing

Soothes Tired Muscles

LOOK AT THESE DREMEL FEATURES

Dremel Sander delivers 14,400 strokes per min., weighs only 2½ lbs.; it's foolproof (has only two moving parts . . . never needs oiling). Dremel Sander operates on 110-120 Volt, 60 Cycle, AC. Thousands and thousands of satisfied users prove its outstanding value.

SATISFACTION GUARANTEED

Dremel Sander comes complete with 6 sheets assorted grade Garnet Paper for sanding, plus felt pad and sheepskin for polishing. If your dealer cannot supply you, use coupon to order direct from factory. **Money back if not delighted after 5 days' trial.**

DREMEL MFG. CO., DEPT. 120-C, RACINE, WIS.

If Your Dealer Cannot Supply You
USE THIS HANDY ORDER FORM

DREMEL MFG. CO., Dept. 120-C, Racine, Wisconsin

☐ Enclosed find $. . . . . (check or money order) in full payment for items checked below.
☐ Enclosed find $2. Ship items checked below C.O.D. I'll pay postman balance plus postage and fee.

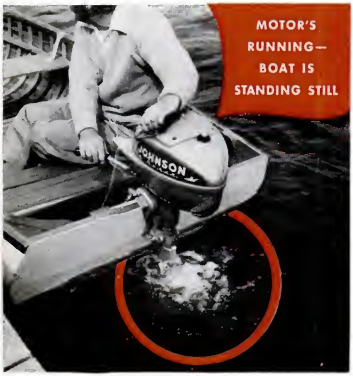
☐ Dremel Sander **$14.85**
☐ Moto-Tool Kit No. 2 **$23.50**
☐ Dremel Coping Saw **$5.85**
☐ No. 2 Moto-Tool, **$16.50**
☐ Drill Press **$9.95**

Send FREE Catalog on ☐ Moto-Tool ☐ Dremel Sander ☐ Dremel Coping Saw

Name. . . . . .

Address. . . . . .

City. . . . . Zone. . . State. . . . . .



JOHNSON

Neutral Clutch

Man, here's a fishin' friend—the new 5 h.p.* Johnson outboard motor with Neutral Clutch and 31 other great features!

Start in neutral. Flip the lever, and GO! Idle, anywhere. Maneuver like an expert.

Go through shallows without a care—with sure-fire Shock Absorber Drive. Ride wide open or at a crawl—your motor runs *smooth* and *cool*. Relax—it's a Johnson, it's DEPENDable!

See your Johnson dealer. Look for his name under "Outboard Motors" in your classified telephone directory. *1950 Johnson prices are lower!*

FREE! HANDY CHART

Complete description of all five 1950 models including the sensational Model QD with Gear Shift Control and Mile-Master Fuel Tank. Sent free. Write!

JOHNSON MOTORS
500 Pershing Road, Waukegan, Illinois
Johnson Motors of Canada, Peterboro, Canada

JOHNSON SEA-HORSES for DEPENDability

NEW MODEL TN. Johnson Neutral Clutch and Full Pivot Reverse. Alternate Firing. Dual Carburetion. Sure-fire Shock Absorber Drive. Vari-Volume Pump. Synchro-Control. Ready-Pull Starter. S-l-o-w Trolling—24 other features. *And no increase in weight or price!*

*OBC *Certified* Brake H. P. at 4000 r. p. m.

Grooved Logs Build Toys

LOGSTIX®, made by Charlen Products, Inc., West Orange, N. J., come in seven lengths. Each length has a different number of grooves that lock into grooves in other sticks. Permanent structures can be made by gluing the sticks. There are 201 pieces in a set.

Road Marker Is Plastic

A PLASTIC, crackproof marker now warns pedestrians and motorists of freshly painted highway lines and other road repairs. Made by Plastic Engineering, Inc., of Cleveland, the marker is unaffected by temperature changes, grease, or abrasives.

DELTA MILWAUKEE®

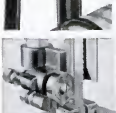
Delta-Milwaukee 14" Band Saws can be found in shops of all kinds — wherever accurate cutting must be done easily and economically.

Hobbyists who want the best in power tools equip with a Delta-Milwaukee 14" Band Saw.

Double table-supports help you get greater accuracy—even on big, heavy work ...with a DELTA-MILWAUKEE® 14" Wood-cutting Band Saw

One of the 2 trunnions that are spaced 9 inches apart to support table.

Upper wheel has blade-tension adjustment. Index shows correct tension for various widths of blades.



You can independently adjust blade guides and blade supports with micrometer accuracy.

Simple attachment increases capacity from 6¼" under the guide to 12¼". Can be added any time.

Widely used wherever folks insist upon highest-quality tools:

- Cabinet Shops
- Carpenter Shops
- Display Shops
- Furniture Factories
- Home Workshops
- Hotels
- Pattern Shops
- Sign Shops
- Theatres
- Upholsterers

— and other places!

Cuts wood, felt, corrugated board, paper, other materials

Two trunnions — widely spaced — one on either side of the blade — support the table of the Delta-Milwaukee 14" Band Saw. This gives you a steadier surface to work on. The table stays rigid, at any angle. You're able to saw more accurately.

That's only one reason why this Delta-Milwaukee machine is first choice of those who know fine tools. There are many other quality construction features:

- Ball bearings are used, giving trouble-free performance — and they are lubricated for life.
- The table is big — 14" x 14". It has a ⅜" x ¾" miter-gage groove. Tilts 45° right and 10° left.
- Blade guide controls can be adjusted safely at the front of the table.
- Aluminum wheels are carefully balanced, so that the blade is true-running.
- Upper and lower wheels are completely guarded, to protect you. Guard covers saw blade at rear; sliding guard covers all but working surface of blade in front.
- Rip gage is available for ripping.

Have your nearby Delta distributor tell you more about these features for safety, accuracy, economy, and convenience. Inspect the Delta-Milwaukee 14" Band Saw there now — and see his *complete* Delta-Milwaukee line.

Look for the name of your Delta distributor under "Tools" in the classified section of your telephone directory.

$235.75* without motor or switch rod

Two machines mounted together — to save space, time, and money

DELTA-MILWAUKEE SAW-JOINTER COMBINATION

Circular saw and jointer mounted on one steel stand and driven by same motor. Both may be operated singly or together. 10" circular saw cuts 3¼" stock. Rips to center of 50" panel. Jointer surfaces boards 6" wide; cuts rabbets ½" deep. Both tools have lubricated-for-life ball bearings. See this dual-purpose machine at your Delta distributor.

Send for free catalog!

*Prices subject to change without notice

TEAR OUT COUPON AND MAIL TODAY!

DELTA MANUFACTURING DIVISION
Rockwell Manufacturing Company
804C E. Vienna Ave., Milwaukee 1, Wis.

Send me free copy of Delta-Milwaukee Catalog B-48.

Name_____

Title_____

Company_____

Address_____

City_____ (___) State_____

HM-6S

Reset loose drawer pulls—

Replaces splintered wood . . . makes loose screws firm!

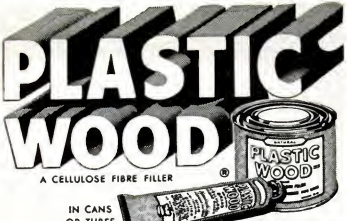
Seal drafty cracks—

Fills openings easily . . . dries tight and hard! Resists weather!

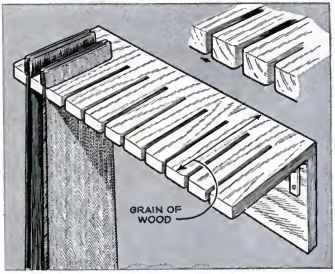
Repair loose tiles—

Holds tiles firm on walls and floors . . . *Easy!*

Also useful in filling cracks in floors, nail and screw holes, repairing broken toys. *Handles like putty . . . hardens into wood!*

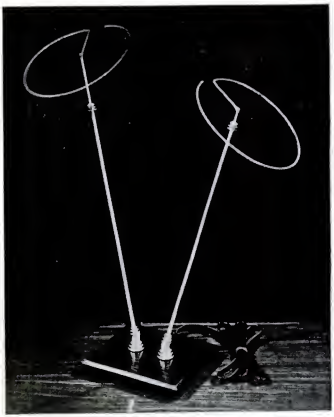


Slotted Shelf Holds Trousers



To MAKE this trousers shelf, cut the slots slightly less than ¾" wide. Widen the entrance of each slot by rounding off the corners. This will make it easier to insert the trousers. Cut the slots with the grain if you use solid stock instead of plywood.—*T. H. Lavengood, South Bend, Ind.*

Circle Dipoles Added to Rods



A NEW indoor television antenna combines both straight and circular dipoles in the arrangement shown. Straight arms are adjustable in length, angle, and rotation; the circles can be angled to any desired position. Gadgets, Inc., Dayton, Ohio makes the antenna. It retails for about $7.

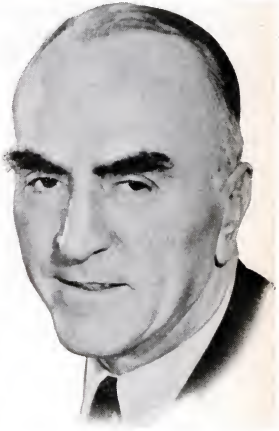
TO EVERY SPARK PLUG USER!

CAPT. EDDIE RICKENBACKER VOLUNTEERS THIS AMAZING STORY ABOUT CHAMPIONS!

President and General Manager of Eastern Air Lines Credits *SAME SET OF DEPENDABLE CHAMPIONS* with 240,000 Miles of Air Travel!

"***THIS SPARK PLUG*** is one of the set of thirty-six (36) which operated in the #4 engine #75737 in Eastern Air Lines' new type Lockheed Constellation #115A for 811 consecutive hours of trouble-free operation. This amount of operating time, which is most unusual, based on an average cruising speed of 300 MPH, is equal to approximately 243,000 miles. During this period the spark plug fired approximately sixty million times. This type of service from a spark plug is remarkable even when compared to the type of operation as recent as a year ago. During its life it was one of the spark plugs (none of which were changed) that helped carry myself and party on our Latin American Tour during August of 1949."

Eddie Rickenbacker



All Champion Spark Plugs, regardless of type or purpose, are products of the same unequalled research engineering and manufacturing facilities. As a result, the same qualities of outstanding performance and dependability, so dramatically demonstrated above, are inherent in every Champion for every engine!

FOLLOW THE EXPERTS *Demand*

AMERICA'S FAVORITE **CHAMPION** SPARK PLUGS

CHAMPION SPARK PLUG COMPANY, TOLEDO 1, OHIO

Listen to the CHAMPION ROLL CALL . . . Harry Wismer's fast sportscast every Friday night, over the ABC network

Oil Loading Speeded Up by T-Shaped Wharf

Five tankers and seven barges can be loaded simultaneously at this wharf almost a mile out in San Francisco Bay, off Richmond. The loading berths are connected to the mainland by a four-lane causeway. Trucks carrying packaged petroleum products travel the roadway; bulk liquid flows through pipe lines alongside the causeway.

The installation, built by the Standard Oil Co. of California, cost more than $5,000,000 and handles in excess of 5,000,000 barrels of crude and refined oils every month.

Planter Runs 3 Times Faster

This new planter sows soybeans at 15 m.p.h., peanuts at 10 m.p.h.—three times the usual rate. Seeds are picked up in holes in a conveyer belt that runs through the hopper. Another belt runs against this to hold the seeds until a drop-out opening is reached. The planter was developed at the Georgia Agricultural Experiment Station.

Boat Blasts Banished

Here's a device to banish the deadly motorboat explosions that made headlines last summer. It's a combustible-gas alarm, contained in the box at left above, that warns of dangerous concentrations of explosive gases. Air from two below-deck locations is fed into it through pipes. Any combustible gases in the samples are burned by hot wires, raising the temperature. When this heat indicates the presence of more than 25 percent of the smallest amount of gas that will cause an explosion, an electrical circuit is closed. This lights a small warning bulb or sounds a buzzer near the helmsman. The alarm is made by the Mine Safety Appliances Co., of Pittsburgh.

Walter Chrysler's original tool chest—on display in the Chrysler Automobile Salon, New York

The tools that money couldn't buy

Walter Chrysler made them himself. He was 17, working in a railroad roundhouse. His mechanic's fingers itched for a kit of tools of his own. So young Walter took steel and made his own.

As he shaped them, he shaped a dream as well. It was a special American kind of dream—free-ranging imagination anchored to solid things like common sense, working a little harder, making things a little better. And asking no odds.

It led Walter Chrysler to success in railroading when he was young. It led him to study the automobiles of the day. Why couldn't a man build *better* cars than any known—nimbler, safer, more comfortable, handsomer?

So, 25 years ago, Walter Chrysler introduced the first Chrysler car. What he did changed the whole pattern of American motoring. He changed it with high-compression engines, 4-wheel hydraulic brakes, all-steel bodies, new ways of distributing weight for better riding . . . many originations the entire automobile industry eventually followed.

As Mr. Chrysler's birthday, April 2nd, approaches and as Chrysler Corporation this year observes its own 25th anniversary, it is fitting to pay this tribute to Walter Chrysler and his genius.

And the tools of his earlier mechanic's days? I remember when he found them in his mother's house. It was long after he had asked me to work with him. He brought the tools back from Kansas. A few of them needed fixing and he asked me to fix them. It was a compliment I have never forgotten.

The qualities Mr. Chrysler put into his own tools still mark the great organization he founded. He built not merely material things; he inspired men with a zeal to carry on his splendid ideals.

Chrysler Corporation is still young enough to feel his inspiration. He wished this company always to be a producer of fine automobiles of great value.

And those of us who were privileged to work with him believe that the new Plymouth, Dodge, De Soto and Chrysler automobiles live up to his tradition.

It is a tradition uniquely American—to live and work with the idea of finding better ways to make what people want.

K. T. Keller *President*

Fine Automobiles of Great Value
PLYMOUTH DODGE DE SOTO CHRYSLER

CHRYSLER CORPORATION

Airtemp • **Chrysler** Marine & Industrial Engines • **Dodge** Job-Rated Trucks • **Oilite** • **Mopar** • **Cycleweld**

Amazing New Fram Engine-Saver

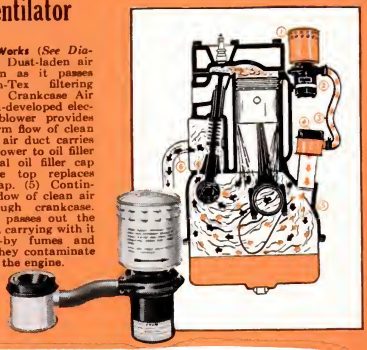
Really Stops Auto Sludge!

Fram Positive Crankcase Ventilator

Here, at last is a new device that provides, for the first time, genuinely adequate crankcase ventilation. It circulates clean filtered air through the crankcase to remove corrosive blow-by gases as they form.

For Stop-&-Go, Low-Speed, and Cold Engine Driving . . . These types of engine operation cause excessive oil contamination and dilution . . . cause sludge, varnish, and asphaltene deposits because under such driving conditions blow-by gases are not properly removed. The Fram Positive Crankcase Ventilator corrects these conditions by providing a constant, uniform flow of clean air through the crankcase and out the road draft tube regardless of engine or vehicle speed. Operates whenever the ignition is on.

Here's How It Works *(See Diagram Right)* (1) Dust-laden air is filtered clean as it passes through Fram-Tex filtering media in Fram Crankcase Air Filter. (2) Fram-developed electrically-driven blower provides constant, uniform flow of clean air. (3) Flexible air duct carries air flow from blower to oil filler pipe. (4) Special oil filler cap with removable top replaces conventional cap. (5) Continuous, uniform flow of clean air circulates through crankcase. (6) Ventilation passes out the road draft tube, carrying with it corrosive blow-by fumes and vapors before they contaminate the oil and foul the engine. Cartridges to fit all operating conditions may be changed in 30 seconds.



Now FRAM Offers You Complete Engine Protection

Engineers have proved that internal combustion engines are the cause of their own destruction. With each explosion in every cylinder, combustion by-products in the form of blow-by gases are forced past the rings into the crankcase. Water vapor, carbon, and corrosive acids attack vital moving parts . . . combine with the oil to make sludge. Results in fouled rings, sticking valves, lost power.

Besides these internally manufactured contaminants, dirt, dust, grit and abrasives enter through the carburetor air intake and the crankcase breather to grind and score mirro-finished engine surfaces. Gas tank condensation and sediment, plus scale, jams carburetor needle valves.

To prevent all these engine killers from cutting miles off your car's life, Fram offers you Complete Engine Protection . . . four great Fram Filters that seal out damaging abrasives and remove internally-manufactured corrosives as fast as they form.

1. Famous Fram Oil & Motor Cleaner . . . "cleans the oil that cleans the engine." Reduces engine wear and lengthens engine life by removing harmful dirt, dust, grit, sludge and abrasives from your oil. Fram Filcron Replacement cartridges remove particles down to one micron (.000039"), offer highest clean oil flow rate, lowest clean-oil cost per mile.

2. Fram Carburetor Air Filter . . . uses completely new, more efficient method to clean the air your engine breathes. Exclusive Fram-Tex dry filtering media removes over 98.5% of harmful dust from air before it enters engine. Easily installed. Low-cost replacement cartridge. Can be changed in minutes.

3. Fram Gasoline Filter . . . removes dirt, sediment, scale and water from gasoline. Protects finely adjusted modern carburetor mechanisms. Cartridge easily changed.

4. Fram Positive Crankcase Ventilator . . . as described above.

Put all four of these Fram engine-savers on your car for Complete Engine Protection. For the name of your nearest Fram Complete Engine Protection Dealer, call your local Western Union Office and ask for OPERATOR 25.

FRAM CORPORATION, Providence 16, R. I.
In Canada: **J. C. Adams Co., Ltd., Toronto, Ont.**

Call WESTERN UNION by number and ask for **OPERATOR 25** *for the name of your nearest FRAM DEALER*

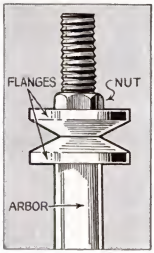
For Complete Engine Protection

FRAM

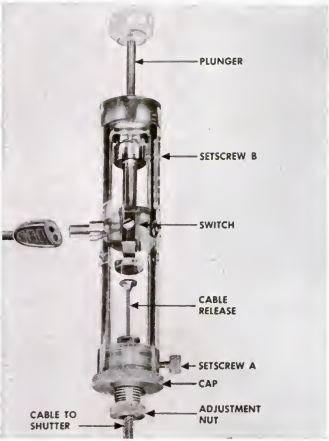
OIL-AIR-FUEL

FILTERS

Flanges Make V-Belt Pulley



A PAIR of beveled grinding-wheel retaining flanges can be assembled as shown to serve as a pulley on a motor arbor or other threaded shaft. A small washer locked between the flanges will give greater space in between for the V belt. —*M. Weisberg, The Bronx, N. Y.*



You Can See Synchronizer Work

ALL working parts of a new photographic flash synchronizer are visible inside its clear plastic case. It can be fitted to most cameras that employ cable releases.

You put it in place by removing setscrew A, turning out the cap, inserting the cable release, and turning back the cap. Then you turn the adjustment nut until the camera shutter releases when the plunger is pressed. Finally, you loosen setscrew B and turn the plunger knob, either clockwise or counterclockwise, to synchronize the switch action with the shutter.

American Cinefoto Corp., New York, sells the synchronizer for about $12.50.

JUST FOR FUN-

reclaim idle space with Western Pines*!

TURN that idle space in attic or basement into a fun room for the whole family! You'll be surprised how easily you can work this transformation when you use versatile Western Pines*. These soft-textured, even-grained woods cut and shape so beautifully, are naturally lovely waxed and rubbed to a mellow glow, stained or painted. Ideal for paneled walls, trophy display shelves, bookcases, record cabinets, gun racks, and other built-ins that give individuality and personality to a family fun center.

You'll enjoy using these woods of the Western Pines* in many workshop projects. This handsome gun-and-rod rack, for instance, for the safekeeping and display of weapons and fishing gear. Sturdy and good-looking when built of Knotty Pine throughout or in a combination of Knotty Pine and Clear Pine. Stain or paint to match room, or finish natural. You'll have satisfaction in making it and pride in its finished beauty!

FREE! IDEA PACKET No. 305-L

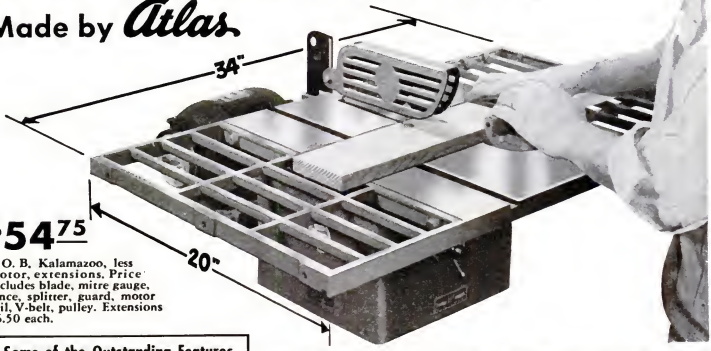
Chock-full of remodeling ideas, illustrated how-to-do-it folders and booklets: New, colorful "Enchanting Homes of Western Pines," "How to Make a Rod and Gun Cabinet," "How to Treat Knotty Pine Paneled Walls." Write Western Pine Association, Dept. 305-L, Yeon Bldg., Portland 4, Oregon.

These are the Western Pines
* IDAHO WHITE PINE
* PONDEROSA PINE
* SUGAR PINE

NEW POWER KING 8" Tilt/Arbor Ball Bearing Saw

A New Standard of Value for you

Made by Atlas



$54.75

F. O. B. Kalamazoo, less motor, extensions. Price includes blade, mitre gauge, fence, splitter, guard, motor rail, V-belt, pulley. Extensions $6.50 each.

Some of the Outstanding Features

- ★ Tilt/Arbor, Ball Bearing Construction! Controls At Front!
- ★ 2⅝" Depth of Cut — Greatest in its class.
- ★ 11½" Table Surface Ahead of Blade on 1" Cut!
- ★ Big Precision-Ground 16"x20" Grey Iron Table! 34" x 20" with two extensions.
- ★ Quick Positioning Rip Fence—Locks At Both Ends!

The Big Capacity and Quality You've Wanted

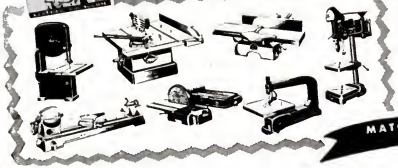
Here — at low cost — is a saw that gives you the capacity you need for any type of construction for your home, the accuracy you need for fine model and furniture projects, and the quality manufacture that assures a lifetime of useful service.

You'll value the big grey-iron table of this new Power King — its solid support for long or wide boards and big panels. You'll value its *permanently* smooth, easy-sliding, *precision-ground* surface — the quick-adjusting, *full-length* rip fence, the convenient *front controls* for blade height and angles, and the tilting arbor, with sealed ball bearings. Only in saws costing much more do you find *all* the quality features that Atlas engineers have put into this new Power King No. 3102.

See it at your nearest Power King dealers at your first opportunity. And for a catalog with many useful woodworking hints, send a postcard today.

NEW! FREE CATALOG SHOWS ALL 8 POWER KING TOOLS

Send a Postcard



ATLAS PRESS Company
342 N. Pitcher St., Kalamazoo, Mich.

Atlas POWER KING

MATCHED PRECISION TOOLS FOR WOODWORKING AND METALWORKING

Take the Thrill-road to Good times!

RIDE A NEW 1950

HARLEY-DAVIDSON

HYDRA-GLIDE

RIDE THE "CHAMP"!
You've got a *new* thrill coming! A touch of the throttle and you're off like a comet! Hills melt away like magic! Rough roads fly beneath you with hardly a quiver of the handlebars. Steering is feather light. Braking is smooth and sure. Day-long riding leaves you fresh and ready for more fun as you take in exciting races, hillclimbs, delightful gypsy tours and club events. Easy payment terms bring you this finest Harley-Davidson of all time. See your Harley-Davidson dealer today. Mail the coupon now!

HARLEY-DAVIDSON MOTOR CO., Dept. P5, Milwaukee 1, Wisconsin

Send for *free* copy of ENTHUSIAST Magazine filled with motorcycle action pictures and stories; also literature on new 1950 models.

Name.....

Address.....

City..... State.....

DEALERS: Valuable franchises available for the full line of famous Big Twins and 125 Model. Your opportunity to line up with the greatest name in motorcycles. Write or wire today.

SHOPSMITH OUTPERFORMS SAWS, SANDERS, LATHES, DRILL PRESSES COSTING $500.00

It's a performance-proved fact! With SHOPSMITH you can do more jobs, actually do better work, than with any $500 combination of single-purpose tools with motors. And here's why:

SHOPSMITH IS VERSATILE! It converts into five big, heavy-duty power tools. Takes all standard accessories. Can do 116 wood, plastic and metal working operations.

SHOPSMITH IS EASY TO OPERATE! Even without practice you can change it from tool to tool *in less than sixty seconds.*

SHOPSMITH TAKES BIG WORK! Its effective table width is so great you can saw to center of 8-foot plywood panels, sand and drill room-length pieces—*with no interference from other tools.* Lathe turns work bigger than a nail keg.

SHOPSMITH IS PRECISION-BUILT! It combines features found only in the finest tools. Grease-sealed ball-bearing action. Induction hardened spindle tip. Centerless ground steel ways. A score of precision features that assure hairline accuracy, lifetime service.

SEE SHOPSMITH DEMONSTRATED! At any Montgomery Ward, leading hardware or department store. And write for *free* 16-page, fact-packed illustrated booklet.

$169.50

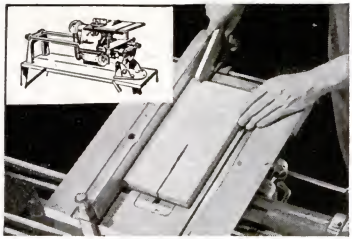
complete except for motor. With special, ½-hp., capacitor type motor (shown) . . $199.50

CONVENIENT TERMS

JIGSAW FOR SHOPSMITH

The finest precision jigsaw you could own

Rugged construction. 18" throat. Large tilting table. Built-in blower. Attaches quickly with one bolt. Can be used also for saber sawing, machine filing. Complete attachment, **$29.95**



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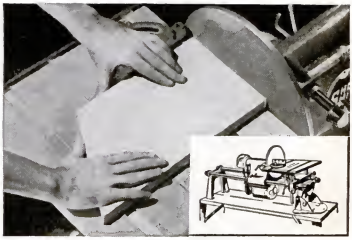

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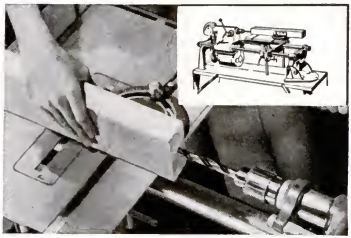

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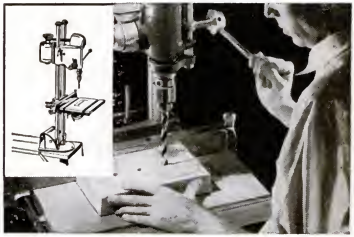
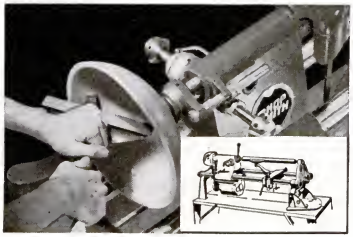


4 Vertical Drill Press. In vertical position, SHOPSMITH is both a bench and floor-type drill press. Drills to center of 15" circle. Has 4" spindle feed with right or left hand feed lever. Jacobs key chuck takes drills from 5/64" to ½" in diameter. Extra-large table.



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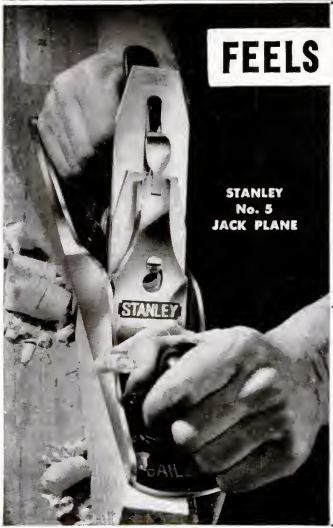

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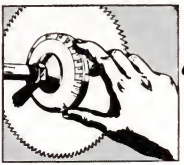

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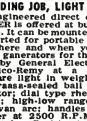

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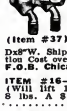

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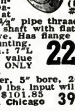

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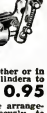

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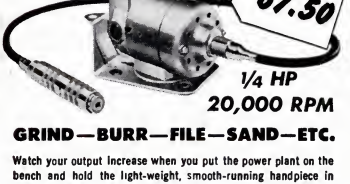

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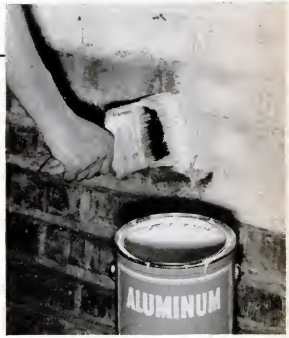

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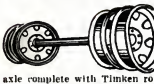

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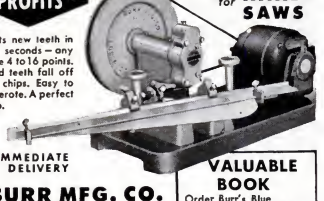

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Get your Scharf 18" Home Craftsmen Level today. If your dealer can't supply you, order from us direct, but you must send dealer's name and address. Satisfaction guaranteed. If you send money order or draft, mailing charges will be prepaid. If C.O.D., mailing charges will be added. **$4.50**

"We Make All Sizes of Levels"

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FOR BETTER LAWNS and GARDENS also POWER MOWERS and RIDING TRACTORS Women can operate it.

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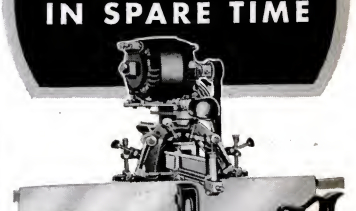
Made $900 IN SPARE TIME



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*Trade Mark Reg. U. S. Pat. Off.

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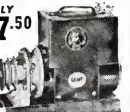

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DEALERS—Send for our folder "A."

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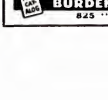

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MOW

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These rugged walking or riding tractors ideal for farm, truck garden, orchard, poultry farm. They operate on a few cents an hour. A child can handle them.

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The Shaw Du-All or Peppy-Pal does many jobs quickly and easily. Plows, cultivates, harrows, disks, bulldozes, sprays, hauls, grinds, and saws wood.

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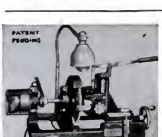

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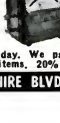

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Sharpens All Reel Type Mowers • Hand, Power or Gang • 10 to 20 Minutes • No Dismantling No Extra Attachments Needed

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Best quality muslin buffing and polishing wheels. 3" diameter, 1/2" thick, 1/2" arbor hole. For metal, plastic or wood. $2.50 value, only $1.00.

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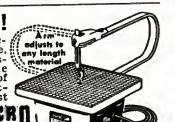

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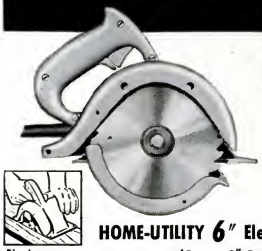

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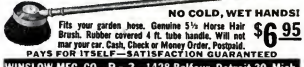

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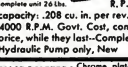

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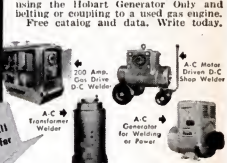

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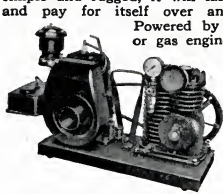

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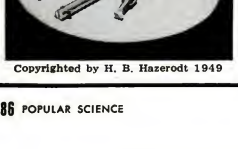

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SET 1.	8 different size High Speed Morse Taper Shank Drills up to ½" with No. 1 and 2 Tapers. $25 value. New and slightly used surplus. Sharpened. Priced at only	$3.85
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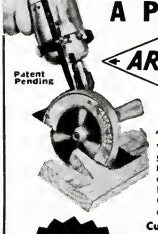

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FITS ANY 1/4", 5/16", 3/8" ELECTRIC DRILL

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"At $2.00 a mower the Foley makes me $4.00 an hour and I am still under doctor's care. How many men punching time clocks can earn $4.00 an hour?"—Frank S. Riley. "Will have my machine paid for and more than $300 clear this season"—says A. W. Bishop.

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FREE BOOK "HOW TO SHARPEN POWER MOWERS" shows just how to sharpen any make of power lawn mower with the Foley. Mail coupon today—we'll also send FREE PLAN telling how to start your own business without previous experience. No salesman will call.

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Send FREE BOOK "How to Sharpen Power Mowers," and FREE PLAN on lawn mower business.

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MODERNIZE *your old Bathtub the easy, inexpensive*

Chromtrim *way!* EASY TO BUY EASY TO APPLY

Follow the simple CHROMTRIM plan and use "thrifty priced" CHROMTRIM metal mouldings with the companion materials you choose.

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King Midget is ideal for errands, sports use, to work, short business or pleasure trips, or second-car utility for the whole family. Also tops for mini-midget racing. Room for six footer.

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POWER HACKSAW $47.25 less motor

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These remarkable tools tipped with TUNGSTEN CARBIDE will astound you with their performance. They work FREE HAND equally well in wood, plastic or soft metals—and at the same time hold their razor-like edge almost indefinitely. Tests show that they will turn wood or plastic for days and days CONTINUOUSLY without showing any signs of dulling. They are the finest tools available at any price. Beautifully finished 2" blade—flush ground, polished tip—finest brass tube ferrule—9" hardwood handle—over all length 14"—25 tools to choose from: round and square nose from 1/8" to 1½"—1/8" cut off; ½"x30° skew, spear, r. & l. skews, turning and parting. Amazing Low Price! Write at once for Free literature.

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EMRICK, INC., 1947 Clinton, Kalamazoo, Mich.

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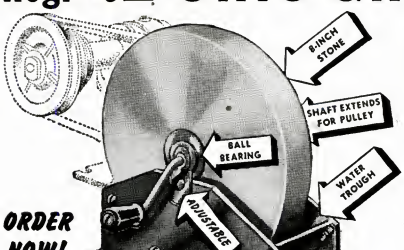

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8" x 1½" WET STONE

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- No Temper removed.
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- Weight 8 lbs., easy to assemble.
- EASILY CONVERTED TO POWER DRIVE *(as shown in illustration)*

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Takes less than 3 hours

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DEALERS WANTED

Also manufacturers of a complete power mower and garden cultivator attachments.

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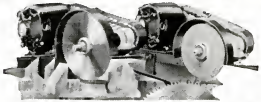
LE CLAIRE, IOWA, Dept. PS

MAKE BIG PROFITS!

OPERATE YOUR OWN SAW-FILING SHOP



● Big earnings are yours with a saw-filing business. Prospects everywhere. Small investment starts you at once! Illus. shows how one Hand Gummer can be adapted to a saw sharpener and/or a cut-off saw. Machine will grind and gum out Rip & Cut-Off saws at any degree, bevel or hook. Also, rounds saws up. Easily adapted to grind skill saws. Up to 20" capacity. $64 each. F.O.B., Portland. Act now!

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For automobiles, homes, refrigerators, milk coolers, brooders, orchards, workshops, etc. Temperature bulb at end of 5 or 15 ft. flexible tube (state which) Dial thermometer glows in dark—non electric—very sensitive— −40° to +50° C. and −40° to +125° F. on same dial. Aircraft quality —worth many times $3.50

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Modernize your car. Fine desk ornament. Reads up to 20,000 feet. Fluorescent dial glows at night — no connections of any kind required — self contained — Suitable as a laboratory standard instrument — Same as used in airplanes. Brand new — cost gov't many times $3.50

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For doors, cabinet work, tool boxes. In full lengths only. Width measured open. Undrilled.

Stainless Steel		Aluminum Alloy	
¾" x 4'	1½" x 6'	¾" x 3'	1½" x 6'
1 1/16" x 4'	2 1/16" x 6'	1" x 6'	2" x 6'
1½" x 6'		1¼" x 5'	

Any size, per foot 20c

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Use on car, boat, darkrooms, workshop, airplanes. White or red light. Small size 3"x3¼"x4¼" Also pulls out 6 ft. on self winding reel. Takes 6, 12, or 24 volt bulb. In durable plastic case. Only $2.50

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For air, oil, hydraulic, gas, etc. Aircraft quality, with 2½" dials. Any range 0-5, 0-15, 0-25, 0-30, 0-100, 0-120, 0-150, 0-200 0-400, 0-1000, 0-1400, or 0-2000 lbs. Also Suction Gauges 0-10 lbs. BRAND NEW $2.50

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Simply hold instrument vertically and trace line or distance to be measured. The index hand on dial shows exact length of measured distance in centimeters or inches. (Multiply for feet, yards or miles).

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- Watch type. Has 2 faces 1 on front, 1 on back
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Comes in genuine leather sheath
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WORLD'S LOWEST PRICED ADDING MACHINE Vest Pocket Size

IDEAL FOR BUSINESS AND PERSONAL USE—GUARANTEED ACCURATE. Not a toy. Operates with only a finger flick. Adds, subtracts, multiplies, divides. Counts up to one billion. Pays for itself over and over. Ideal Gift—for Business, Income Tax and School use. MONEY BACK GUARANTEE. Send name and address. Pay postman only $2.95 plus postage. (Send full cash if outside U.S.) Beautiful rich-looking Leatherette Case included at no extra cost. Money back in 10 days if not delighted. AGENTS WANTED.

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FACTORY TO YOU $59.95

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Removes without water — Paint, Tar, Grease, Ink, etc. Quickly — Easily — Contains Lanolin. PREVENTS CHAPPING AND ROUGH, RED HANDS. SEND $1.00 FOR TWO 60c TUBES — POSTPAID. Money-Back Guarantee — Agents Wanted.

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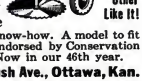

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Price **$12.50** Why Pay More

Build Your Own

Rotary Type Lawn Mower

We Supply Cutting Unit Complete.

NO INCREASE IN PRICE

TRACTOR-LITE MFG. CO., SPIRIT LAKE, IOWA

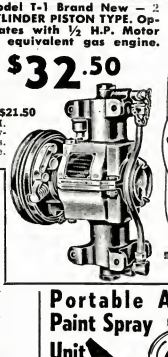
"Wellworth" Sensational Offer! Reg. $60.50
WESTINGHOUSE AIR COMPRESSOR

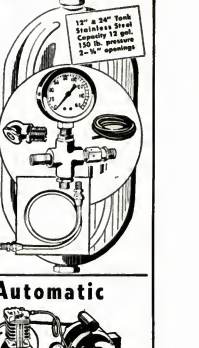
Model T-1 Brand New — 2 CYLINDER PISTON TYPE. Operates with ½ H.P. Motor or equivalent gas engine.

$32.50

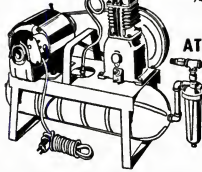
Compressor, pressure tank, air gauge, air chuck, 20-ft. hose, pop valve, copper tubing with 4 brass flared fittings for connecting compressor to tank, 4-way cross and 3 nipples. COMPLETE OUTFIT, wt. 52 lbs.

Equipment less Compressor, $12.50. Compressor separately, $21.50
Compressor has 2" bore, 1⅛" stroke, ball bearing. 3.27 CFM at 600 R.P.M. Capacity up to 6.54 CFM. Size 9"x11⅞"x6⅝". Wt. 26 lbs. Ideal for spraying paints, insecticides, etc., inflating tires, operating air tools, and other uses. All new equipment. U.S. government surplus. Replacement parts available. Amazing buy. Don't miss it.





PORTABLE SPRAY OUTFIT



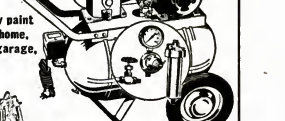
¼ H. P. HEAVY DUTY MOTOR
EXTERNAL ATOMIZING GUN

Paint Sprayer mounted on 6 x 24 inch tank, ¼ H.P., 110 V. 60 cy. Heavy duty motor with overload relay, 10 ft. cord and plug. V belt drive. Piston type Compressor with 2 Compression rings, 1 oil ring. 2 inch Bore, 1¾ inch stroke, displacement 2.86 C.F.M. at 60 lbs. pressure. Safety Valve. Gun external atomizing. Flat and round spray, quart cup; maintains 35 to 40 lbs. working pressure. Oil and water extractor. 1 air gauge, 20 ft. heavy duty 2-braid air hose carrying handle, with leak proof fittings, complete with Net weight 54 lbs., ship. wt. 60 lbs.

$57.50 COMPLETE OUTFIT

Outfit less motor. Wt. 30 lbs. **$47.50**
Compressor only. Wt. 14 lbs. **17.50**
Spray gun and 20 ft. hose. Wt. 7 lbs. **12.95**

Portable Automatic Paint Spray Unit



Spray paint your home, car, garage, etc.

Complete outfit Including Spray Gun. $150.00 Value.

$89.50

Same unit, stationary, $79.50
Use also for spraying insecticides on plants and flowers. ½ H.P. heavy duty capacitor motor, AC 110/220 volt, 60 cycle, 2 x 1¾ inch piston type compressor, splash feed lubrication, 12½ x 24 inch tank, automatic pressure switch, CFM 2.8 at 100 lbs. pressure, or 150 lbs. pressure for intermittent duty. Check valve, safety valve, air regulator with gauge and filter, spray gun with 20 ft. air hose and air chuck for inflating tires. V belt drive. Mounted on 2 wheels, ball bearing, with 2" x 1" pneumatic tires. Portable, with handle. Shipping wt. 90 lbs. Regular $150.00 value. ONE YEAR GUARANTEE. Only $89.50 complete.

PARTS SOLD SEPARATELY

Compressor	17.50	wt. 16 lbs.	
Automatic pressure switch	7.50	wt. 3 lbs.	
Regulator, gauge and filter	8.50	wt. 5 lbs.	
Spray gun	9.95	wt. 4 lbs.	
Tank, wheels and base	17.50	wt. 32 lbs.	
20 ft. hose	2.95	wt. 6 lbs.	
½ H.P. Cap. motor	22.50	wt. 28 lbs.	
Air gauge	1.75	Adjustable pop valve	1.50
¼" check valve	2.75	wt. 2 lbs.	

PNEUMATIC AIR TOOLS

USED, GUARANTEED LIKE NEW.

CHICAGO PNEUMATIC RIVETER & CHIPPING HAMMER
CP4X Pistol grip handle. Takes up to 3/16" rivet. Weight 6 lbs. List price $75.00.
Ideal for work on fenders and auto bodies
SPECIAL PRICE **$10.95**
Same as above, brand new **$22.50**

Chicago Pneumatic Lever Type AIR DRILL
With ¼" Jacob Chuck. Wt. 2 lbs. List price $55.00. Only **$14.95**

Ingersoll Rand AIR DRILL
With ¼" Jacob Chuck. Wt. 2 lbs. List price $55.00. Only **$14.95**

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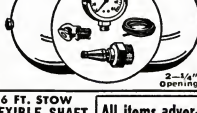
Motor guide, air compressors, home and factory workshop tool catalog. Send 10c to cover postage and handling.

AIR TANK and ACCESSORIES

Air receiver, stainless steel, 12½"x24", 400 lb. test. Ideal for carrying on trucks, autos and wherever compressed air is needed. Equipped with 500 lb. air gauge, tire chuck, 3 ft. high test air hose, air inflation valve with core for retaining pressure in tank, and fittings.
Complete outfit **$6.95**
Shipping wt. 20 lbs.
Tank only **$4.95**



50 CFM Blower 2½" discharge $6.95

6 FT. STOW FLEXIBLE SHAFT

Reduced Price
Only $14.50

Heavy Duty, ⅜" Core. Best piano wire. Ball bearing handle and arbor, rubber core housing; for ½" motor shaft; for ½" bore wheels. Operates on ¼ H.P. Motor at 1725 or 3450 R.P.M. $29.50 Value, $14.50. Wt. 8 lbs.

All items advertised on this page are guaranteed BRAND NEW

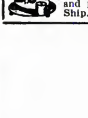
"Wellworth" BLOWER
at a Bargain Price

Quiet operating. Double wheel inlet, double width blower. For heating, ventilating, cooling, air washing, exhausting and forced draft. DIMENSIONS: 10" wheel, outlet 13¼"x11⅜"; inlet 8¾". Height 19". Width 18". Depth 16½". C.F.M. 1,200 S.P. 1600; outlet vel. 1575; motor ¼ H.P. with overload relay; cord & plug, 110 v. 60 cy. AC. Ship. Wt. 67 lbs. Special price **$39.50**

140 CFM "WELLWORTH" BLOWER

Single inlet blower that gives top performance on heating, ventilating, exhausting, cooling, drying and similar applications. 5⅛ x 4" mounting flange with 2½" square discharge, 3⅛" dia. blower wheel powered by direct-connected 1/15 H.P., 110 V., 60C., A.C. motor with conduit box and 20" leads. 7¼" x 7¼" less flange by 7¼" ft. x 6¾" D. Suited for hundreds of new and replacement uses. Shpg. wt. 8 lbs. **$14.20**

300 GAL. COOLANT PUMP
A Heavy-Duty Pump at 40% Less



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	1,000	10,000	25,000	50,000	100,000	500,000
.641	$.25	$.21	$.19	$.17	$.15	$.13
832 834 1032	.31	.28	.25	.23	.21	.19
1/4-28	.39	.36	.33	.30	.27	.25
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K6AR-48	1-3/32	23/64	5/16	30¢
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3L24BM	7-3/32	4-23/32	1 1/8	7.50
209V	3-11/32	1-3/4	17/32	1.95
		NEEDLE		
B-1616P	1-1/4	1"	1"	45¢
B-3424	2½	1-7/8	11/32	1.25
		ROD END (Thread 3/8 x 24)		
	I.D.	Length	Thick	
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Thickness Approx.	Width	Price per run yds.
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#330 .064 1/16"	36"	2.39
#331 .092 3/32"	36"	3.29
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Note: No. 329 is Laminated rubber sheet with cloth center. Flexible & very fine for heavy wear.
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Complete with Maytag, Power Products or Briggs-Stratton Engine —18" rotary tool-steel, fully guarded blades—cast aluminum body. Cuts grass and weeds, wet or dry—does all trimming—chops grass into fine mulch, eliminating raking. Send check with order, or specify C.O.D. Write to Dept. S-3 for literature.

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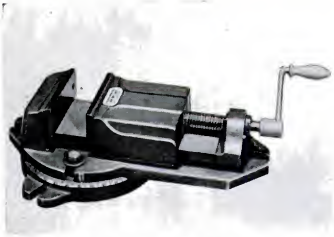
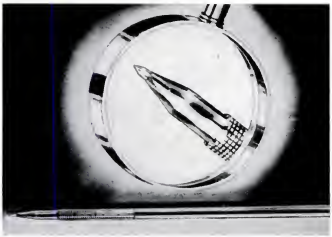


New Machinist's Vise. To keep the inside of the vise free of dirt and chips, this unit is built without T slots or bolt holes. The maker, Parma Manufacturing Co., of Parma, Mich., contends that this feature saves swiveling and clamping time because bolts need not be worked around in chip-filled slots. The vise is made in two models, one 4" and the other 5" high with base. The lockplate for the swivel permits locking anywhere in the 360° swing.

Accessories Fit 1/4" Drill. Included in this kit manufactured by Whirl-A-Way Inc., of Cleveland, is a right-angle attachment that cuts drill speed in half for heavy-duty work, three grades of sanding disks, a wool buffing bonnet, and a circular carpet pad for use with cutting and rubbing compounds. The attachments can be used directly as well as with the right-angle drive.

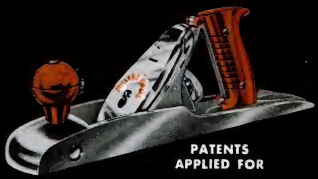
Tools



New Scriber. A tungsten carbide tip is brazed into the handle of this scriber, made by the Niagara Instrument Corp., Lockport, N. Y. According to the company, the tip can be sharpened many times without burning or softening. The scriber also can be used on rusty work, the point cleanly penetrating hard scale such as is sometimes found on boiler plate. The knurled shank is 5″ long. Retail price is about $1.

Jigsaw Has Direct Drive. A direct, beltless drive from a ¼-hp. motor gives this 56-lb. jigsaw exceptional cutting speed, according to the maker, Beebe Brothers, of Seattle, Wash. The saw will make inside and outside cuts in wood up to 2″ thick and is built with either an 18″ or 24″ throat. Other features are the full-length tilting table, front-end table lock, and enclosed steel cabinet. The 18″ model is priced at $57.50 with motor; the other at $69.50.

The Finest Planes in the World



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- 27x28 in. table, 13½ in. capacity in front of blade
- 10 in. blade cuts 3¼ in. deep. Tilts full 45 degrees
- Floor model 34" high table always stays level
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- Jackscrew and 4½ in. dia. handwheel lowers and raises blade
- Cast aluminum miter gauge and self-aligning rip fence guide

GIL-BILT Metal Parts Kit includes Plans, ball bearing arbor, miter gauge and bar, rip fence guide, dado insert, lock knobs, jack screw mechanism and handwheel, and all other metal parts (less blade) $20.95
Same Kit with 10" Combination Blade . $24.90
Same Kit with 8" Combination Blade . $23.90

GIL-BILT 8-INCH TILTING TABLE SAW

- 21x27 in. table tilts full 45 degrees. 13 in. capacity in front of blade
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GIL-BILT Metal Parts Kit includes Plans, Ball Bearing Arbor, Miter Gauge and Bar, Rip Fence Guide, Machined Lock Knobs, Tilt Support Segments, and All Other Metal Parts (less blade) $15.95
Same Kit with 8" combination blade $18.90

GIL-BILT 12-INCH BAND SAW

- Cuts to center of 24 inch circle
- Handles stock up to 6 inch thick
- 18x18 inch table tilts 45 degrees
- Lower wheel and drive pulley runs on sealed New Departure Ball Bearings; Upper wheel runs on two ⅝" bore Oilite Bronze bearings.
- Upper wheel tension and tilt mechanism of cast aluminum, completely assembled.
  - (Upper and lower blade guides. Each has ball thrust bearing, self-lub bronze jaws.
  - Rubber tired wheels. Choice of cast aluminum or make-your-own wood wheels on metal hubs.
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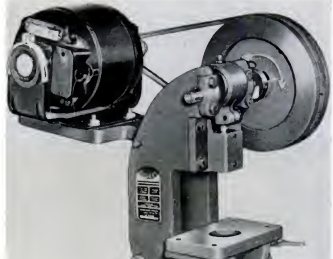
259 Strader Ave. Cincinnati 26, Ohio

New Tools



Midget Punch Press. This one-ton press, made by the Benchmaster Manufacturing Co., Los Angeles, handles all conventional jobs such as punching, shearing, staking, riveting, forming, and coining. The price is about $80.

It has a maximum stroke of ¾" and a ¾" hole in the ram. Approximate speed is 290 strokes per minute with a ¼-hp. motor. The alloy-steel crankshaft is ¾" o.d., rotating in replaceable bronze bushings. The 20-lb. flywheel measures 9" in diameter. With the ram up, the die space to the bolster plate is 3¾". The throat depth is 2⅛" and the weight, less motor, is 65 lb.

Utility Tool for Home or Shop. Four screwdrivers and a hammer are combined in this tool. The screwdrivers are stored inside the hammer handle. All handles are brass and the bits and hammer head are tool steel. The tool, priced at about 75 cents, is made by the G. M. Co. Manufacturing Inc., Long Island City, N. Y.

It's Fun! Assemble This Miniature Antique 1900 Packard for $2.50!

BE "The man who owns one"

You'll be proud of your Packard, too. This authentic, ¾" scale model, priced at $2.50, is one of 8 famous antique autos that make up Hudson Miniatures' "OLD TIMER" line of auto construction sets. Colorful, accurate in detail, easy to assemble, economical to buy. Start your collection today.

See them at your local hobby store or write to us direct. In ordering, please add 25c for postage and packing.

1911 Maxwell	$2.50	1910 Model "T" Ford	$2.50
1903 Model "A" Ford	$2.50	1903 Rambler	$2.50
1904 Oldsmobile	$1.95	1909 Model "T" Ford	$2.95

1909 Stanley Steamer.....$2.95

Hudson Miniatures' "OLD TIMERS"

SCRANTON HOBBY CENTER, Dept. 28, Scranton 10, Pa.

World's Largest Stocks of Jeep Parts

Write for Your Special Requirements—We Can Fill Any Order!

The King of Jeeps

GUARANTEED REBUILT JEEP MOTOR BLOCKS

COMPLETE WITH PAN (Less Head)

This motor is completely rebuilt with all new parts. Guaranteed for 90 days or 4000 miles against defective parts or workmanship. You must prepay freight when shipping old block to us. Add $2.50 for crating to above prices.

$88.50 Exchange

$107.50 Outright

NEW RADIATOR ASSEMBLY

Complete with Shroud. Interchangeable with Civilian Jeeps.

$24.95

MUFFLERS

$2.75

A6118—Oval Type

EXHAUST PIPES A10199

Complete from manifold to muffler.

$3.50

CRANKSHAFT BEARINGS

A6798 Std.	.....	$3.10
A6746 .010	.....	3.90
A6747 .020	.....	4.10
A6728 .030	.....	4.10

CONNECTING ROD BEARINGS

All sizes. Each.....45c

BUMPER SNOW PLOW

$69.50

Easy to install. Brand new. All steel. F.O.B. Buffalo, N. Y.

MASTER CYLINDER Complete ASS6-GPW2140

$5.95

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Thousands of other parts and accessories available. SHOP BY MAIL — Order direct from this ad today.

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BERG TRUCK & PARTS CO., INC.

1603 So. Wabash Avenue, Dept. S-3, Chicago 16, Ill.

Cable Address . . . JEEPKING

MEET THE NEW BULL SAW!

Convert your electric drill into a powerful, portable saw for only $9.95

Your electric drill becomes a portable saw with power to spare when you attach the new Bull Saw! It's sturdy, rigid—yet light enough for *one-hand* operation. New visual guide lets you see where you're going; new extra wide shoe plate keeps saw blade on the straight-and-narrow. One-piece safety guard of polished aluminum . . . blade of high-carbon steel . . . double bearings for long life. Fits rigidly on any ¼" electric drill. Depth of cut: 1½". OUR GUARANTEE: *This tool is as outstanding in design and performance as the Bull Buffer.* Complete, ready to use as pictured..... **$9.95**

(When ordering, ask for Model BS-C)

IF YOU ALREADY OWN A BULL BUFFER

13

you can make your own Bull Saw for only $7.50! Here's how: Order the saw housing (photo 13) and attach it to the angle-head of your Bull Buffer following the simple directions we send you. That's all — it only takes 30 seconds to change your Bull Buffer into a powerful, portable saw! The housing you need comes complete, only..... **$7.50**

(When ordering ask for Model BS-H)

COMPLETE POLISH-SAND-'N-SAW KIT

2

Includes (a) Bull Buffer* (photo 2), the famous right-angle polisher-sander, complete with rubber pad, sheepskin bonnet, 2 sanding discs, and (b) Saw Housing (photo 13) that fits on Bull Buffer angle-head to give you a powerful Bull Saw. A $19.90 value —but this kit is yours for only **$14.95**

(When ordering ask for Model BS-K)

***BULL BUFFER ONLY, without saw housing, $9.95**

At your dealer, or send cash, check or M.O. for prepaid shipment

BERTRUM C. ENGINEERING CO.

3121 Main Street — Kansas City, Mo.

P.S. Last minute news & notes...

SCOOP: "Some day soon, a brand-new chemical element seems likely to be added to the 96 now known," said last month's PS (p.143). The forecast speedily proved correct. While the February issue was on the press, word came from Berkeley, Calif., that Element No. 97 has been discovered. Dr. Glenn T. Seaborg announced it has been made in the University of California cyclotrons. He said it would probably be named "berkelium" in honor of the university city.

HOT BEDS for seedlings are easily heated electrically with Thermotape (t) made by Smith-Cates Corp., Plainville, Conn. The flexible, flat tape is looped under the soil layer and connected through a thermostat.

RADIO BILLIARDS. Microwaves are being "bounced" around a Pennsylvania mountain to provide radio communication between a power plant and sub-station. They are beamed at a 20-foot-square aluminum mirror on a 50-foot pole - which reflects them to a receiving station on the other side of the mountain.

ROLL ROOFING of a new type has a layer of aluminum laminated over half the width of the felt. Laid in asphalt the usual way, it provides two layers of felt topped by metal, saving weight of gravel topping and reducing heat transfer. Reynolds Metals Co. makes it.

POLAROID LAND Cameras, which turn out finished pictures in a minute (PS, Feb.'49, p.232), report that 8 million pictures were snapped in their first year on the market. Amateurs are big users, but business use is increasing.

COLD-START BATTERY developed for Army use down to 40° below has been put on market by Reading Batteries, Inc., Reading, Pa. Makers say it has double the starting power of average battery at sub-zero temperature.

WATER-CONTROL cylinder in a new GE automatic washing machine is adjustable. It enables a housewife to reduce water consumption 40 percent when washing a small load of clothes.

TV RECEIVERS have about 1,100 component parts - 10 times as many as ordinary radio sets. Some experts predict the television industry at its peak may employ 10 times as many people as radio.

The Editors

This One
UACJ-30U-KH8A
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New scintillation counter, using electron tube developed at RCA Laboratories, gives faster, more accurate measurements of atomic radiations.

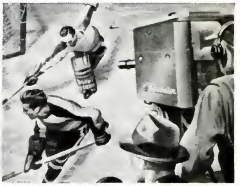
What can you hear through an ***ear of grain****?*

When agriculturists want to learn what nourishment a plant is getting, they inject radioactive materials into the soil and trace their absorption with sensitive instruments. Industry and medicine also use this ingenious technique.

Until recently, scientists *heard* what was happening, followed the passage of atomic materials with a clicking Geiger counter. Now a more sensitive instrument —*a new scintillation counter* made possible by a development of RCA Laboratories—can do the job more efficiently.

Heart of this counter is a new multiplier phototube so sensitive that it can react to the light of a firefly 250 feet away! In the scintillation counter, tiny flashes, set off by the impact of atomic particles on a fluorescent crystal, are converted into pulses of electrical current and multiplied as much as a million times by this tube.

See the newest advances in radio, television, and electronic science at RCA Exhibition Hall, 36 West 49th Street, New York. Admission is free. Radio Corporation of America, Radio City, N. Y.



The principle of RCA's multiplier phototube is also used in the supersensitive RCA Image Orthicon television camera, to give you sharp, clear television pictures in dim light.

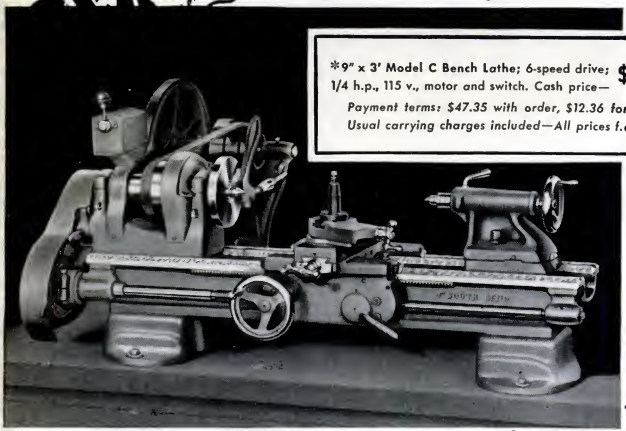
RADIO CORPORATION of AMERICA

World Leader in Radio — First in Television

Hoot Mon! Look what $47.35* puts in your shop!

*9" x 3' Model C Bench Lathe; 6-speed drive; 1/4 h.p., 115 v., motor and switch. Cash price— **$187.35**

Payment terms: $47.35 with order, $12.36 for 12 months. Usual carrying charges included—All prices f.o.b. factory.



Install this fine lathe in your shop now and let it help pay for itself. Capable of a wide variety of operations, this lathe is ideal for general machine work in the small shop and for machining small parts in the large shop. A complete line of practical attachments and accessories simplify the tooling of this lathe for many special classes of work.

All sizes of South Bend Lathes, 14" Drill Presses, and 7" Bench Shapers are available on comparable time payment terms: 25% down, 12 monthly payments. Reasonable finance charges.

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SOUTH BEND LATHE
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Send for Information:

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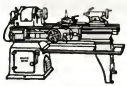
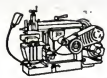


☐ 10" TO 16" FLOOR LATHES



☐ 7" BENCH SHAPER

☐ 14" DRILL PRESSES

☐ ½" and 1" Collet TURRET LATHES

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Mechanic For ir Line

qualify me Radio Me- nited Air- by Radio- Class Li- Hauger, California.

More Money With Own Shop

"Am doing Radio Servicing full time. Have my own shop and am making more money now than I ever did before. Owe this to N.R.I."—Curtis Stueth, Fort Madison, Iowa.

Graduate Doubles Salary

"I am employed by Station WKBO, as transmitter operator. Have more than doubled my salary since starting in Radio full time."—A. A. Herr, New Cumberland, Pa.

$10 Week Extra In Spare Time

"I averaged $10 a week fixing Radios in my spare time. After graduating, managed an electrical store's Radio Department."—M. Joseph, Sacramento, California.

"To-day I an expert I vision Tech 4 employee me. Radi ness has d G. Miller,

BE A SUCCESS IN RADIO-TEL

Learn by Practicing at Hon

Get a GOOD JOB--Have a BRIGHT FUTURE in America's Fast Growing Industry

Do you want a good pay job in the fast growing RADIO-TELEVISION Industry? Or do you want to have your own money-making Radio-Television Shop? Here is your opportunity. I've trained hundreds of men to be successful Technicians . . . MEN WITH NO PREVIOUS EXPERIENCE. My tested and proved train-at-home method makes learning easy. You learn Radio-Television principles from my illustrated lessons. You get practical experience building, testing and experimenting with MANY KITS OF PARTS I send. All equipment yours to keep.

MAKE EXTRA MONEY IN SPARE TIME

The day you enroll, I start sending you SPECIAL BOOKLETS that show you how to make $5, $10 a week or more EXTRA MONEY fixing neighbors' Radios in spare time while learning. From here, it's a short step to your own shop or a good pay Radio-Television servicing job. Or let me train you for a Federal Communications Commission (FCC) License. Be a Radio-Television operator or Technician.

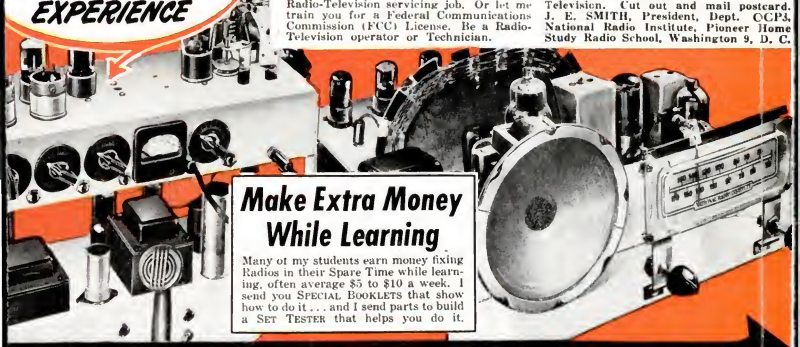
TELEVISION OFFERS NEW JOBS—MORE JOBS FOR TRAINED MEN

In 1945, there were 943 Radio Stations. Today, about 2700 are on the air! RESULT—THOUSANDS OF QUALIFIED MEN STEPPED INTO GOOD JOBS. Another example—only 19 Television stations were on the air in 1947. Today, more than fifty. Within a few months, 150, say the experts — and 1000 within 3 years. Then add developments in FM, Two Way Radio, Police, Marine, Aviation, Micro-wave Relay Radio. Think what this means! New jobs, more jobs for qualified men. The man who prepares NOW can reap rich rewards in this changing, developing, fast growing field!

SEE WHAT N.R.I. CAN DO FOR YOU

Act Now! Send for two BOOKS FREE. Actual Lesson on Receiver Servicing and 64-Page Book on winning success in Radio-Television. Cut out and mail postcard. J. E. SMITH, President, Dept. OCP3, National Radio Institute, Pioneer Home Study Radio School, Washington 9, D. C.

I SEND YOU ANY KITS LIKE THESE FOR PRACTICAL EXPERIENCE



Make Extra Money While Learning

Many of my students earn money fixing Radios in their Spare Time while learning, often average $5 to $10 a week. I send you SPECIAL BOOKLETS that show how to do it . . . and I send parts to build a SET TESTER that helps you do it.

FIND OUT ABOUT THIS TESTED WAY TO BETTER PAY MAIL NOW!

NOTED THROAT SPECIALISTS REPORT ON 30-DAY TEST OF CAMEL SMOKERS...

Not one single case of throat irritation due to smoking CAMELS!

YES, THESE WERE THE FINDINGS OF NOTED THROAT SPECIALISTS AFTER A TOTAL OF 2,470 WEEKLY EXAMINATIONS OF THE THROATS OF HUNDREDS OF MEN AND WOMEN WHO SMOKED CAMELS—AND ONLY CAMELS—FOR 30 CONSECUTIVE DAYS!

COLLEGE STUDENT Anne Hogan: "My doctor's report after my 30-day test proved what my own throat told me from the start—Camels are wonderfully *mild!*"

MR. AND MRS. RICHARD COLE of Fresh Meadows, N. Y., made the test under observation of a throat specialist. Both agree, "Camels are the mildest cigarette!"

PERSONNEL DIRECTOR Robert R. Lamkie: "Camel mildness agreed with my throat from the start. I like everything about Camels—my cigarette!"

R. J. Reynolds Tobacco Company, Winston-Salem, N. C.

Start your own 30-Day Camel MILDNESS Test Today!

Smoke Camels—and only Camels—for 30 days. Compare them in your "T-Zone" (T for taste, T for throat). Let your own throat tell you about Camel's cool, cool mildness. Let your own taste tell you about Camel's wonderful flavor.